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TRS-80
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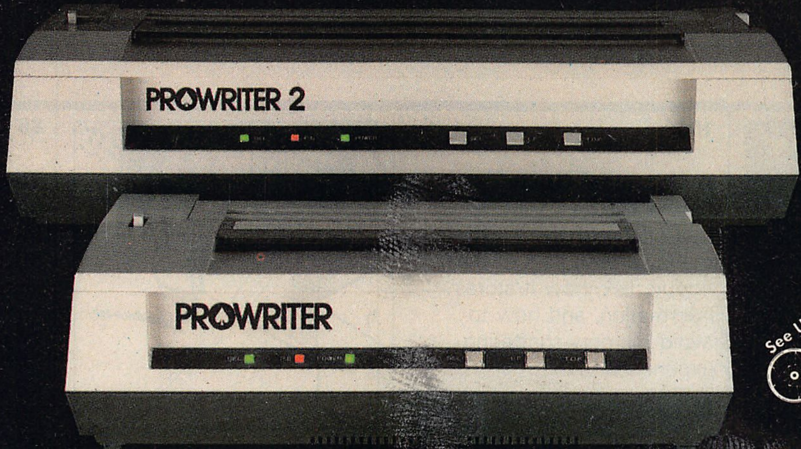

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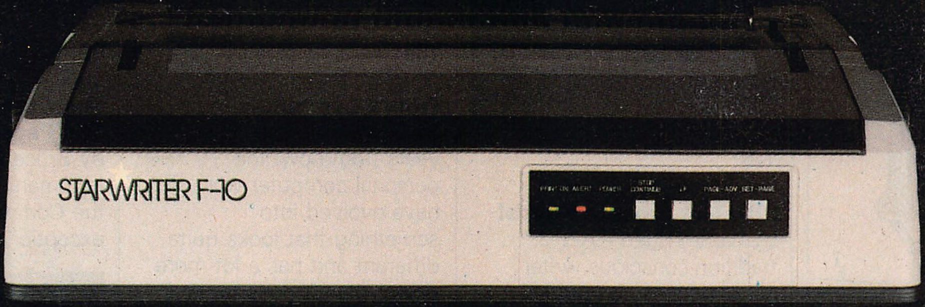

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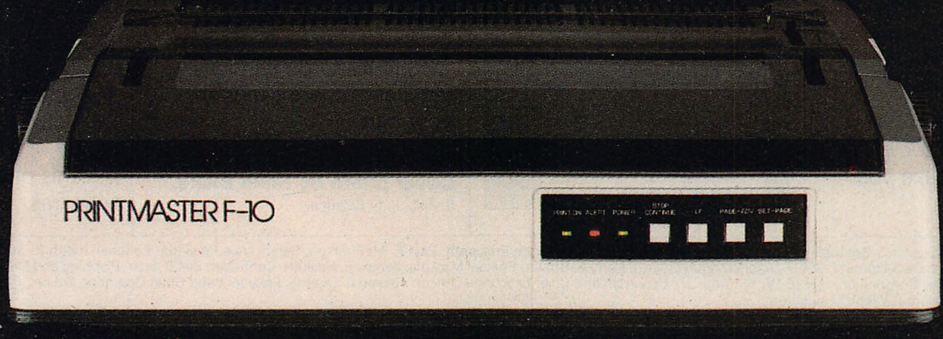

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Vol. 2, No. 7 May 1983

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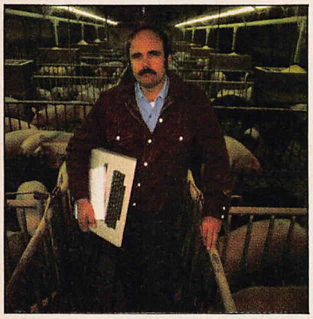

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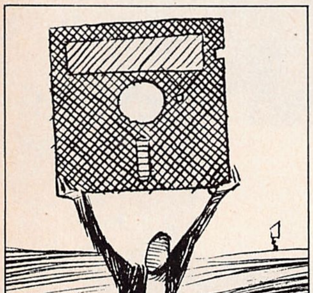

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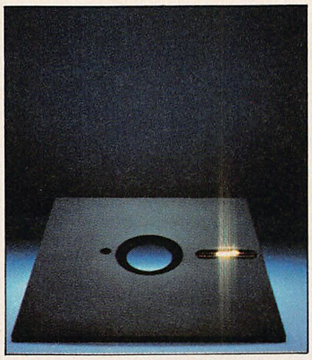

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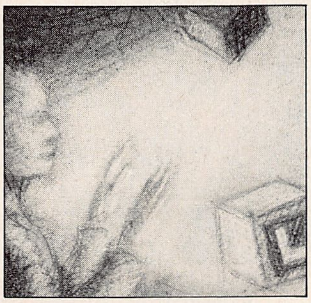

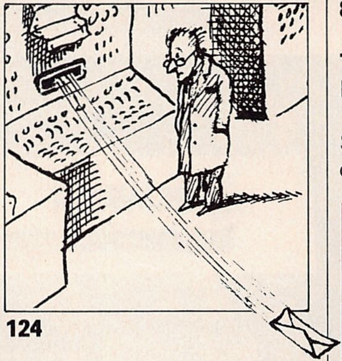

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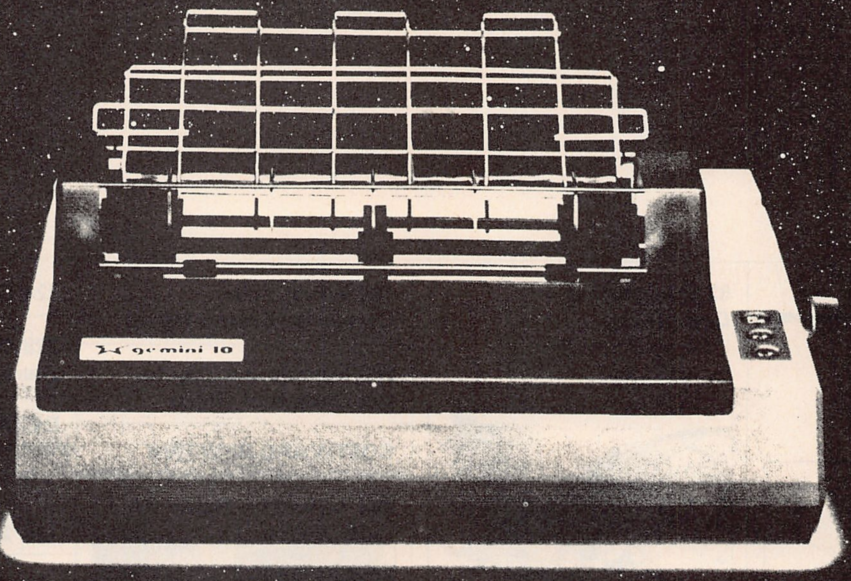

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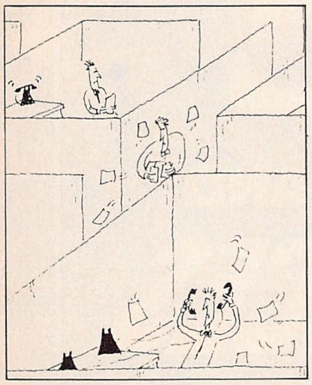

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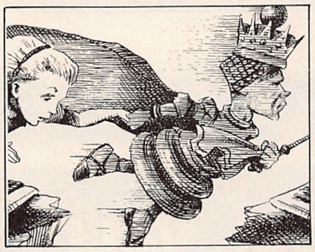

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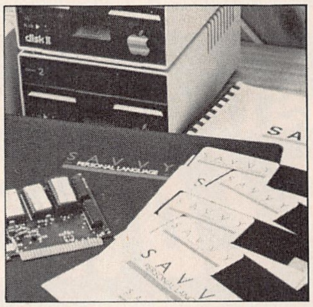

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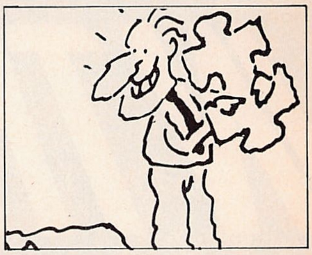

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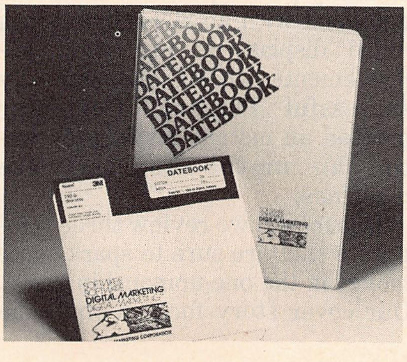

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Playing the Game of One-Upmanship

Computer companies are frantically playing the one-upmanship game. The rules are simple. One manufacturer introduces a new product and barely gets it onto dealer shelves when another company comes out with an improved version at a lower price. The newer product either shortens the life of the original product or forces a price reduction.

This scenario has been repeating with increased intensity of late. Clive Sinclair was the first to prove that there's a huge market for a $100 computer. If a company wanted to compete on Uncle Clive's turf, it had better offer an enhanced product at the same price or a lower price. Other companies, of course, have noticed Sinclair's success. Texas Instruments recently unveiled its $100 99/2. There are industry rumors that Radio Shack plans to introduce an under-$200 home color computer. Timex will soon begin distributing the Timex 2000 (Sinclair Spectrum)—a beefed-up color version of the Timex 1000—for less than $200.

Last year Adam Osborne bundled best-selling software and portability. His odd-looking Osborne 1 became an instant success. Kaypro quickly countered with a similarly priced portable computer equipped with an 80-column 9-inch video display, among other improvements. IBM's phenomenally successful Personal Computer created an instant market for we-too-can-run-the-same-software machines.

This month we review three computers that are sure to spark some moves in the one-upmanship game. Our cover story focuses on Radio Shack's Model 100 (page 86). With its built-in word-processing, record-keeping, and telecommunications software, eight-line display, easy portability, and under-$800 price tag, the Model 100 looks like a sure winner.

Fully compatible with Radio Shack Model III software, the LNW-80 (page 178) has even more features than the Model III. But the LNW-80's advantage may be short lived as Radio Shack will surely respond to the challenge with an upgraded version of the Model III.

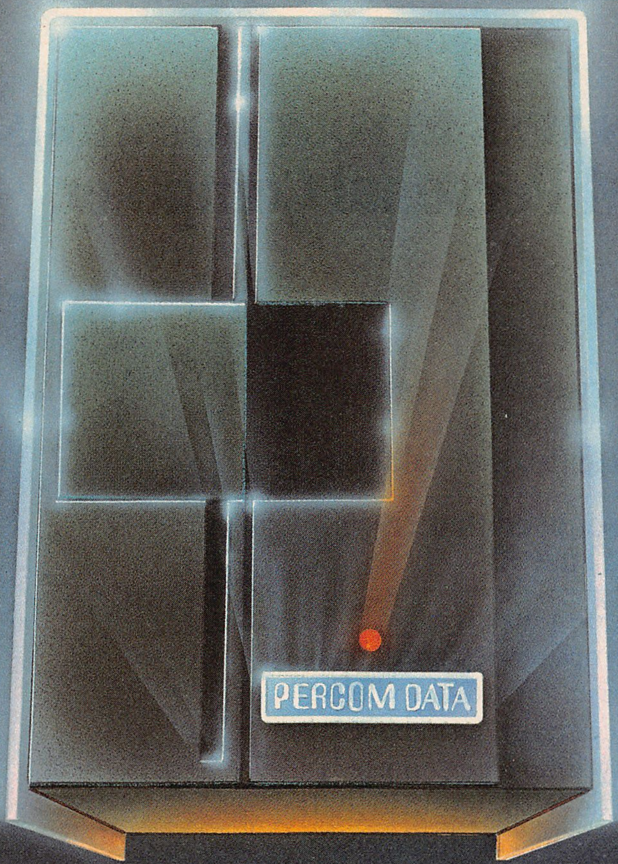
Considering all its features and low price, the Commodore 64 (page 92) has set a new standard that other companies will be forced to match or beat. Sources at Commodore tell me the 64's price will soon drop to $350.

All the components for a dramatically different low-cost personal computer now exist. As our article "Future Computers" (page 136) suggests, it won't be long before some enterprising entrepreneur combines all these elements into a fantastic computer at an unbelievably low price.

As consumers, we can only benefit from the fierce competition between computer companies. The big question as always remains, "What's next?" We'll keep you informed about the players and their moves in this exciting game of one-upmanship.

Rich Friedman

Rich Friedman
Managing Editor



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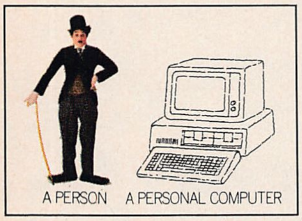
"Just what is a personal computer, and how can I use it?"



The IBM Personal Computer is a computer designed for a *person.* It's a tool to help accomplish just about anything a person needs to do with information. It can help a businessperson solve complex problems just as surely as it can help a small child improve his or her arithmetic.

"Suppose I've never had my hands on a computer. How 'easy' will it be?"

GUIDE TO OPERATION

As with any new tool, you'll want to get comfortable with the IBM Personal Computer before putting it to serious use. You'll have some step-by-step reading, but our instructional literature involves you from the start. And the computer is on your side too—interacting with you as you learn.

There's no reason why you can't be executing programs and feeling good with the results within your first week. After a month, it should be clear that you've made a good investment, and you'll probably be telling your friends why they should get one.

"Is the IBM Personal Computer simpler or more advanced than others?"

Both. Our system has been engineered with many advanced design features (see the chart) but their purpose is to make it simpler for you. Our ten function keys are a good example. We added them to save you a lot of time and error. They are *advanced* features that add to *simplicity* and ease of operation, and that is typical of our total design.

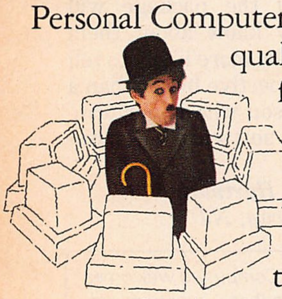
"What kind of software programs do you have to help me?"

IBM Personal Computer software comes in many varieties, and it's all quality.

For example, if planning is part of your work, we have VisiCalc*— the "electronic worksheet." If you maintain a business, we offer programs that help handle everything from accounting to inventory and payroll record keeping. We also have carefully chosen programs for educational use, intelligent games, a word processing program, plus communications packages that connect you and your computer to outside information services via your telephone and a device called a modem.

"How expensive and how expandable is it compared to others?"

Because of the extraordinary amount of advanced, built-in features available in the IBM Personal Computer, it can give you more quality, power and performance for your money. You're also buying extraordinary expandability—beginning with user memory that can be increased up to 32 times. (In the chart at right, one needn't be a technical whiz to add up all the features that make our personal computer a very good buy indeed.)



IBM PERSONAL COMPUTER SPECIFICATIONS

User Memory
64K-640K bytes*

Microprocessor
16-bit, 8088*

Auxiliary Memory
2 optional internal diskette drives, 5¼" 160K bytes or 320K bytes per diskette

Keyboard
83 keys, 6 ft. cord attaches to system unit*
10 function keys*
10-key numeric pad
Tactile feedback*

Diagnostics
Power-on self testing*
Parity checking*

Display Screens
Color or monochrome
High-resolution*
80 characters x 25 lines
Upper and lower case

Operating Systems
DOS, UCSD p-System, CP/M-86†

Languages
BASIC, Pascal, FORTRAN, MACRO Assembler, COBOL

Printer
All-points-addressable graphics capability
Bidirectional*
80 characters/second
18 character styles
9 x 9 character matrix*

Permanent Memory
(ROM) 40K bytes*

Color/Graphics
Text mode:
16 colors*
256 characters and symbols in ROM*
Graphics mode:
4-color resolution: 320h x 200v*
Black & white resolution: 640h x 200v*
Simultaneous graphics & text capability*

Communications
RS-232-C interface
SDLC, Asynchronous, Bisynchronous protocols
Up to 9600 bits per second

*ADVANCED FEATURES FOR PERSONAL COMPUTERS

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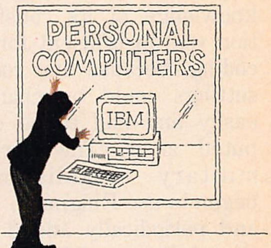

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Poland's Contribution

Dear Editor:

"Confessions of a Computer Scientist" by Jacques Vallee (February 1983, page 85) brought to mind many fond memories of the late 1950s when many of us were just starting our careers in computer science using a big IBM 650. It is amusing to observe that the IBM Personal Computer, with which I am writing this letter, has capabilities similar to those of the IBM 650.

Vallee's description of the part the Enigma decoding effort played in the development of computers needs to be supplemented for the sake of historical accuracy because it erroneously places the construction of the first "Bomb" decoding machine in England.

In fact, the original work on decoding the Enigma system was done in Poland: in 1931 a commercial version of what later came to be known as the Enigma machine was acquired from Germany. The knowledge of its construction was insufficient for decoding because its coding settings could be changed easily and had to be computed anew. The German military establishment began to use Enigma in 1934 and periodically added further design modifications to complicate decoding.

The decoding was the work of three Polish mathematicians: Marian Rejewski, Jerzy Rozycki, and Henryk Zygalski, all graduates of the department of mathematics at the University of Poznan. They joined the decoding establishment erected in 1936 at Pyry, about 6 miles south of Warsaw, where they were able to decode the Enigma messages as early as 1936 and keep up with later changes in the German encoding machine.

Because each change in the encoding mechanism made by the Germans increased the work needed for decoding, it was decided to mechanize the effort. The first primitive Bomb decoder was constructed to the designs of Rozycki in 1938 and six machines were placed in operation, one for each encoding rotor in the Enigma. The arrangement was capable of decoding the key to the machine setting in two hours. The information on decoding the Enigma messages was shared with the French, who had a treaty of alliance with Poland and who secured early encoding books for the machine from a German defector.

After a Treaty of Alliance was signed between Poland and Britain in 1939, copies of the reconstructions of the latest model of the Enigma and the plans for the Bomb decoding computer were transferred to the French and the British. This constituted what was probably Poland's most significant contribution to the Allied war effort. By passing along this information, Poland laid the foundation for the decryption work so brilliantly continued during the war at Bletchley. The first decoding of Enigma messages was accomplished at Bletchley in 1940 and more powerful models of the Bomb decoding machine were constructed there later.

The full details of the Enigma-Bomb story are given in Jozef Garlinski and Tadeus Lisicki's book *The Enigma War* (published in 1980 by Scribner). Most of this story was classified until quite recently.

Jacek Jedruch
Pittsburgh, PA

Right to Left

Dear Editor:

Congratulations on your February 1983 issue, which was the most interesting and enjoyable one I have read to date. You seem, however, to have had consistent difficulty with your Hebrew. In the first instance, the illustration on page 37 for a Synergistic Software foreign-language translation and tutorial program shows the Hebrew phrase running from left to right, whereas it should obviously have gone the other way. The eight other language expressions say "Do you speak. . .(name of language)," while the Hebrew one says "Who speaks Hebrew?" (As well, the last letter of the Russian phrase is incorrect.)

Furthermore, John Edwards' review "The Disk-Based Bible" (page 128) notes that "Jewish scholars . . .will have to cope with many differences from their Aramaic version." Actually, apart from sections of Ezra and Daniel written in an Aramaic dialect, the Jewish bible is definitely written in Hebrew.

Steven D. Stellman
Brooklyn, NY

We thank Mr. Stellman and other sharp-eyed readers for pointing out the reversal of that Hebrew phrase on page 37.

Speed Is Not the Whole Story

Dear Editor:

The article "How to Buy Software" by William Barden Jr. (January 1983, page 54) contained some excellent advice and guidelines for choosing software, but "Tip #5: Buy Programs in Assembly Language" requires further clarification.

Programs written in assembly language (also called machine language) do run much faster than equivalent programs written in BASIC or other high-level languages, but because software developers usually require more program lines to accomplish a given function in assembler than in a high-level language, the end product will take longer to complete and have higher development costs. For products with broad appeal, such as word-processing or financial-planning packages, the higher development costs are distributed among a large number of customers, which brings the cost per package down to a reasonable price. If the developers do not have a large enough potential market for their software, they will have to pass these higher costs on to their customers, making the assembly-language software more expensive.

The last item in Mr. Barden's software evaluation checklist offers the most valuable advice: contact local users for their evaluations. If there are any performance problems with the package a buyer is considering, other users of the package will probably know about them and will be more likely to tell the prospective buyer than a salesperson who is performing a software demonstration.

Alan B. Hartmann
Piscataway, NJ

Popular Computing welcomes your feedback regarding articles that appear in this magazine as well as your comments about the personal computing field in general. Write to Letters, *Popular Computing*, POB 397, Hancock, NH 03449. (Due to the number of letters received, we cannot respond individually.)

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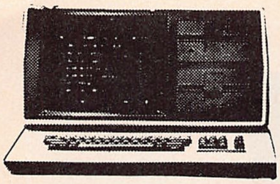

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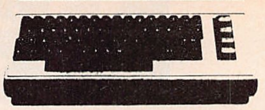

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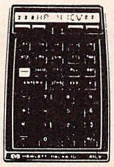

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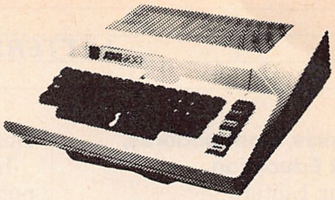

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Apples, Commodores, and Education

Dear Editor:

I was dismayed to find that the advice given by Dan Watt in his article "Which Computer Should a School Buy?" (December 1982, page 140) is woefully outdated. Mr. Watt counsels educators to buy Apple II microcomputers (as opposed to those manufactured by Atari, Commodore, Radio Shack, and Texas Instruments) because they are, he says, the only microcomputers with an extensive software library that supports (or that will support) the educational programming language Logo. This advice became obsolete nearly six months ago with the introduction of the Commodore 64. The manufacturer committed itself, in advertisements appearing as early as last June, to make the languages UCSD Pascal, PILOT, and Logo available for the Commodore 64.

Feature for feature, the Apple II, which I think is overpriced, doesn't hold a candle to the 64. Even Apple's Chairman Steven P. Jobs, according to a recent article in *International Business Week*, concedes that Apple is in need of a "heart transplant." The bit-mapped graphics of the Commodore 64 have double the resolution of those of the Apple II. And, despite their limitations, plug-in ROM cartridges are the most cost-effective way of programming a computer (the Apple II has no such provision). In addition, the built-in music synthesizer on the 64 is a potentially valuable educational tool. Finally, the 64 can run both Apple and CP/M software by using plug-in modules. In my opinion, any educator who purchases Apple IIs, instead of Commodore 64s, is grossly mismanaging public funds.

Angus C. Fox III
Guri, Venezuela

Dear Editor:

In his article "Which Computer Should a School Buy?" Dan Watt compares the Apple II, the Radio Shack Model III, the Atari 800, and the TI 99/4A in the under $2500 category. However, he fails to mention Commodore's latest entry in this market, the Commodore 64.

The 64 comes standard with 64K bytes of memory, color graphics, sprite graphics, and music—all for $595 and with one disk drive for $990. To top it all off, the Commodore 64 has a huge selection of educational software, including CP/M, UCSD Pascal, Logo, and a PET emulator, which makes all PET software available for the 64.

Although all this software is not available at the time, the Commodore 64 will provide the most computer for the least money.

Farhad Ghaussy
East Hampton, CT

The Commodore 64 is an attractive addition to the group of computers that should be considered for school purchase. (See our full review of the 64 on page 92 of this issue.) With its outstanding graphics, animation, and sound capabilities, the 64 is likely to be a viable school computer for quite some time. Commodore Logo, which should be available by the time you read this, requires the use of a disk drive, at an additional cost of $395.

Educational software that takes advantage of the 64's unique capabilities should become available in quantity as the 64 itself secures a strong foothold in the home and school markets. Much of the educational software currently available for the 64 was originally developed for the PET and does not take advantage of the additional memory, graphics, color, animation, or sound capabilities of the 64. Commodore is working with publishers to ensure that older software is converted for use with the 64 and that new software is created for it.

Purchasers of the 64 should be extremely cautious about claims that it will be able to run software developed for other computers such as the Apple II. Because of differences in graphics, disk operating systems, and other factors, Apple software may need a great deal of modification before it can run on the Commodore 64. Before purchasing an accessory to make the 64 load Apple software, we advise you to test it thoroughly or wait until such a product can be fully reviewed. . . . D.W.

How Much User Memory in the Commodore 64?

Dear Editor:

I believe you had a memory error in Robert Schilling's article "Now. . . How Much Memory Does It Really Have?" (January 1983, page 112).

In the closing paragraph it says "Commodore rates its systems according to the net user workspace. . ." This may be true of the Commodore PET mentioned earlier in this article, but not the Commodore 64 system.

Of the Commodore 64's 64K bytes of RAM, 39K are user-accessible for BASIC programs or 52K for machine-language programs.

So we find that when "Commodore rates its systems" it doesn't use the same scale for all its machines.

Jeffrey S. Strnad
Chicago, IL

Holmes Should Have Known Better

Dear Editor:

Sherlock Holmes had an interesting idea in using a keyword to construct a cipher table ("Elementary BASIC," December 1982, page 120). To save myself the tedious DATA work in lines 580–830, I wrote the following routine:

```
280 L = R + C + 70
282 IF L< 91 THEN 288
284 L = L - 26
286 GOTO 282
288 T$(R,C) = CHR$(L)
```

Instead of the READ statement in line 280, I used the statements in the (new) lines 280–288 to fill the cipher table array. Since Holmes knew about the ASCII code (lines 390–400) it would have been logical to use it with the CHR$ function in this manner.

Ir. J. Liek
Vlissingen,
The Netherlands

"Sexist" Headline

Dear Editor:

I am very disturbed at the sexist slant of your magazine. "Do Women Resist Computers?" by Ellen Jaffe McClain (January 1983, page 66) presented strong, well-researched facts that totally contradicted the insinuation in the title. The bold type on the cover, "Do Women Resist Computers?" suggested to me (and several friends) that the answer was "yes." But upon turning to page 66, we find an italicized paragraph stating that "quite the opposite" is true. You should have considered a title such as "Women May Change the Course of Computing!"

Bonnie Hawkins
Blackwood, NJ

"Job Well Done"

Dear Editor:

Your January feature entitled "Do Women Resist Computers?" was absorbing and thought provoking. I have always felt that your publication conveys the scope and human drama of computing much better than your rival magazines do. And, in my opinion, this article proves it!

I was getting sick and tired of all those cranky Letters to the Editor you usually print. It's high time that someone wrote to you to say "job well done."

Niles C. Ludwig
New York, NY

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I have an Apple II with programs written in Pascal. Is there any way to translate them into BASIC? Ted Dreyfus, Lafayette, LA

In general, translating from one language to another is feasible, but we know of no commercial products that do so.

Translators are huge programs containing the logic required to "understand" the original or source language and the target language. They work by replacing each keyword or construct from the source language with its analog in the target language.

For example, a translator might change the following Pascal program into the BASIC equivalent beneath it:

```
(* 3 TO THE 4TH POWER *)
I := 0;
R := 1;
WHILE I < 4 DO
BEGIN
R := R * 3;
I := I + 1
END
```

```
10 REM 3 TO THE 4TH POWER
20 I = 0: R = 1
30 IF I< 4 THEN 50
40 GOTO 90
50 R=R*3
60 I = I + 1
70 GOTO 30
80 END
```

Both programs calculate 3 to the 4th power. However, the translator is ignorant of the purpose of the program, and therefore it is unable to recognize the fact that a single BASIC statement, R = 3 ↑ 4, produces the answer more efficiently.

Another problem exists in that translators are unable to take full advantage of enhancements in the target language. Similarly, if the source language contains features not present in the target language, the translator program is stuck. (For example, Pascal provides for user-defined data types, but BASIC has no such provision; therefore Pascal programs using the feature cannot be fully translated.)

Because of problems such as these, translators can typically process only a part of the source program—perhaps 80 percent. The remaining portion must be translated by hand, frequently the most difficult part of the process.

Figure 1: Symbols of the International Phonetic Alphabet; many speech therapists would like to display these on their personal computers. That's possible, but it requires custom software.

	bilabial	labio-dental	dental and alveolar	retroflex	palato-alveolar	alveolo-palatal	palatal	velar	uvular	pharyngal	glottal
Consonants											
Plosive	p b		t d	ʈ ɖ			c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ	n	ɳ			ɲ	ŋ	ɴ		
Lateral fricative			ɬ ɮ								
Lateral nonfricative			l	ɭ			ʎ				
Rolled			r						ʀ		
Flapped			ɾ	ɽ					ʀ		
Fricative	ɸ β	ɱ v	θ ð s z ɹ	ʂ ʐ	ʃ ʒ	ɕ ʑ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Frictionless continuants and semivowels	w ɥ	ʋ	ɹ				j (ɥ)	(w)	ʁ		

		front	central	back
Vowels				
Close	(y ʉ u)	i y	ɨ ʉ	ɯ u
Half-close	(ø o)	e ø	ə	ɤ o
Half-open	(œ ɔ)	ɛ œ		ʌ ɔ
		æ	ɐ	
Open	(ɒ)	a		ɑ ɒ

I am a voice teacher/therapist and I use the International Phonetic Alphabet (IPA) extensively (see figure 1). I have been searching for a program that is able to display and print the IPA symbols in an interactive tutorial program. Sam F. Haynes, St. Louis, MO

We haven't located any programs designed specifically for that purpose, but perhaps some of our readers can help.

If you use a high-resolution computer and/or printer with the right graphics software, it shouldn't be too difficult to program the characters yourself. Look for programs that let you create and use your own character sets. Several are available for Apple, IBM, TRS-80, and other personal computers.

By the way, a number of speech therapists are using computers along these lines, but many do not use the IPA system. One alternative system called SPEEC (Sequences of Phonemes for Efficient English Communication) consists of more than 400 basic sound units that are reportedly able to specify speech with more precision than is possible using the IPA. The basic units were derived using an exhaustive computer study of sound/letter correspondence. For a listing of the basic sounds in this system, write to Melanie Fried-Oken, Tufts New England Medical Center, Engineering Rehabilitation Department, 171 Harrison Ave., Box 1009, Boston, MA 02111. Enclose a stamped, self-addressed envelope.

In ZX81 BASIC, how can I set up a two-dimensional array of strings? The DIM statement allows two subscripts, as in

```
DIM A$(25,10)
```

The first subscript sets the number of elements in the array, and the second subscript sets the string length for each element, not the number of columns in the array, as one might expect. In other words, A$ (,) is really a single-dimension array, or list, of strings. Is there a way to get around this limitation? T.W. Reese, South Hadley, MA

ZX81 is not the only BASIC with this limitation. In fact, several "tiny" BASICs limit you to a single dimension for numeric as well as string arrays.

To simulate a two-dimensional array of size R by C, let the one-dimensional array be of size R × C. To locate array element (I,J), use this formula:

$$S=J+((I-1)\times R)$$

where S is the subscript you need in the single-dimension array.

A sample BASIC program

Ask Popular is a monthly department in which we answer general questions about small computers. Send your questions to: Ask Popular, POB 397, Hancock, NH 03449. Due to the large number of letters received, we cannot answer each question with a personal letter.

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for the ZX81 is shown in listing 1, below.

I'm interested in using the C programming language. Can you give me the names of companies that produce and sell microcomputer versions of it? William E. Word, Fountain Valley, CA

C is a high-level structured programming language developed by Bell Laboratories. (A structured language is one that encourages or helps programmers write programs that are broken down into logical subunits that interact with each other in a carefully planned fashion. Structured programming is particularly useful when you're creating large applications programs.)

Several C compilers are available for microcomputers (compilers translate the source code into machine language before it is executed). Here's a sampling of manufacturers and the computers they support:

Aztec C runs on CP/M, MP/M, CP/M-86, Apple DOS, and MS-DOS systems. Contact Manx Software Systems POB 55, Shrewsbury, NJ 07701 (201) 780-4004.

BDS-C runs on CP/M systems. Contact Dedicated Micro Systems Inc., 112 N. Main St., POB 287, Yates Center, KS 66783 (316) 625-2361 (mornings only).

C/80 runs on CP/M systems and Heath/Zenith HDOS systems. Contact The Software Toolworks, 14478 Glorietta Dr., Sherman Oaks, CA 91423 (213) 986-4885.

C86 C runs on CP/M-86, MS-DOS, DEC Rainbow, Victor 9000, Altos 8600, and other systems. Contact Computer Innovations Inc., 75 Pine St., Lincroft, NJ 07738 (201) 530-0995.

Digital Research C runs on 8086- and 8088-based systems and allows the development of applications for CP/M and Unix operation systems. Contact Digital Research, POB 579, Pacific Grove, CA 93950.

Introl-C runs on CP/M, OS-9, Flex-09, and Uniflex systems. Contact Introl Corporation, 647 West Virginia St., Milwaukee, WI 53204 (414) 276-2937.

Q/C runs on CP/M systems. Contact The Code Works, Suite 224, 5266 Hollister, Santa Barbara, CA 93111 (803) 683-1583.

Small-C runs on the IBM Personal Computer. Contact Caprock Systems Inc., POB 13814, Arlington, TX 76013 (817) 261-4493.

Telecon-C runs on CP/M, Flex, Uniflex, RT-11, RSX-11, PDP-11, and MS-DOS systems. Contact Telecon Systems, Suite 218, 1155 Meridian Ave., San Jose, CA 95125 (408) 275-1659.

Whitesmiths C runs on CP/M, Unix, Iridis, RSX-11, RT-11, RSTS, IAS (LSI-11, PDP-11), VMS (VAX-11), and Versados (Motorola 68000) systems. Contact Whitesmiths Ltd., Building B, Parkway Towers, 485 U.S. Route 1 South, Iselin, NJ 08830 (201) 750-9000.

For a definitive description of C, read *The C Programming Language* by Brian Kernighan and Dennis Ritchie (Prentice-Hall, 1978).

Another book you might try is *Learning to Program in C* by Thomas Plum (Plum Hall Publishers, One Spruce Ave., Cardiff, NJ 08232 (609) 927-3770.)

For further help with C, contact the C Users Group, POB 287, Yates Center, KS 66783.

In a previous column (December 1982, page 12), reader Mary Shurin asked where she could learn about servicing microcomputers. You recommended the NRI course in microcomputers and microprocessors. I subscribed to the course a while back but was disappointed to find that it provides only a general background in computer electronics and technology. It is not geared toward starting a career in microcomputer service. NRI's advertising seems to imply just the opposite.

What does NRI have to say about this? Woody Beckman, Irvine, CA

We forwarded your letter to Lou Frenzel, Executive Director of the NRI School of Electronics. His reply should be of interest to many *Popular Computing* readers. It reads, in part:

"The NRI course in microcomputers and microprocessors was designed to teach microcomputer servicing. However, because of the broad nature of the course, it is simply impossible to get into the nitty-gritty details of each and every machine. The main purpose of the

Listing 1: How to build two-dimensional string arrays in ZX-81 BASIC.

```
10 REM DEMO OF 2-DIMENSIONAL STRING ARRAYS IN ZX-81 BASIC
20 REM STORE THE NUMBER OF ROWS YOU NEED IN R
40 REM STORE THE NUMBER OF COLUMNS IN C
50 REM STORE STRING LENGTH IN L
60 REM S IS CALCULATED FROM A ROW/COLUMN PAIR AND IS THE TRUE SUBSCRIPT FOR THE ARRAY
70 LET R=10
80 LET C=5
90 LET L=15
100 DIM A$(R*C,L)
110 REM FILL ARRAY WITH DATA
120 FOR I=1 TO R
130 FOR J=1 TO C
140 PRINT “ENTER DATA FOR ROW”; I; “COLUMN”; J
150 LET S=J+(I-1)*C
160 INPUT A$(S)
170 NEXT J
180 NEXT I
190 PRINT
200 PRINT “ENTER THE ROW AND COLUMN PAIR”
220 PRINT “ROW MUST BE FROM 1 TO”; R
230 INPUT I
240 PRINT “COLUMN MUST BE FROM 1 TO ”; C
250 INPUT J
260 IF I<1 OR I>R OR J<1 OR J>C THEN GOTO 200
270 LET S=J+(I-1)*C
280 PRINT “THAT LOCATION CONTAINS:”; A$(S)
290 PRINT
300 GOTO 200
```

course is to provide a solid background in electronic, digital, and microcomputer fundamentals and an introduction to servicing techniques. With this background, a graduate has the prerequisites to handle additional training on specific machines and is ready for actual job experience.

"As part of our program we include the TRS-80 Model III computer. There is just no substitute for hands-on experience in learning about microcomputers. However, we intentionally limit the hardware access the student has for several important reasons.

"First, the computer is a major investment for the student. If we let the student mess around inside, the Radio Shack warranty would be voided. To give the students the same warranty benefits as any Radio Shack customer, we keep them out of the inside of the machine.

"As it turns out, this is a good decision because there's very little to do inside the machine even if you do make the decision to break the warranty. The ICs are not socketed but soldered in place, and therefore very little experimentation can be done.

"Another element that held us back was the lack of suitable test equipment. As you know, it is difficult to do much hardware work without a good oscilloscope. We did not feel we could justify adding a scope to the course and increasing its price, nor did we feel that it was fair to require a student to purchase a scope for that work.

"We do get into the computer via the bus with a ribbon cable coming out to our experimental breadboard. All kinds of input/output interfacing experiments and programming demonstrations are performed.

"In our March 1983 Electronics Catalog, we will be announcing an updated version of the course. In it, we include procedures for memory expansion and disk-drive addition (by the time the student comes to this section, the Radio Shack warranty has expired, anyway). We have also added four additional lesson texts to expand our coverage of microcomputer servicing as well as peripherals and data communications.

"Overall, the NRI course is an outstanding program and certainly our most popular offering. We get few if any complaints like Mr. Beckman's." *Louis E. Frenzel, NRI, 3939 Wisconsin Ave. NW, Washington DC 20016.*

What's the difference between raster graphics and vector graphics? S. Flowerree, Santiago, Chile

The terms describe two totally different approaches to producing graphics on a display or printer.

With vector graphics, a picture is described and generated in terms of lines on an imaginary *x,y* grid. A typical vector-graphics command looks like this:

LINE (10,15)–(30,22)

and indicates a line connecting the points (10,15) and (30,22). Plotters use vector graphics exclusively.

With raster graphics, images are generated by a series of closely spaced parallel lines containing combinations of dots and spaces. If you look closely at your television picture, you'll see that it is created using raster graphics. Most printers and computer displays also use raster graphics.

Vector information can be converted to raster information by software. This technique allows you to do plotting on an ordinary dot-matrix printer.

The reverse process, converting from raster to vector information, is more complicated and is not often used in personal computers. □

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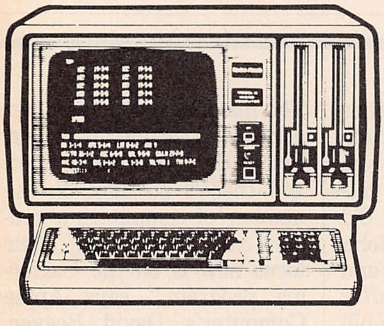
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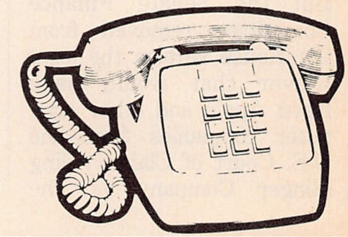

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"Apple Bill" Reintroduced

Supporters of the Computer Equipment Contribution Act—the so-called Apple Bill that the U.S. House of Representatives passed by a lopsided vote but the Senate gunned down in last December's lame-duck session—have confidently reintroduced the bill in both chambers.

By the time the measure ran the gauntlet of the Senate Finance Committee, so many extraneous items had been tacked on that even Apple itself was displeased with its content. Finally, committee member Sen. Howard Metzenbaum put a hold on the bill to prevent its reaching the Senate floor for a vote. In its original form, the House bill sponsored by Rep. Pete Stark (D-California) called for a change in the tax code so that companies donating computers to public schools could claim tax deductions equal to the sum of production costs plus half the difference between those costs and the computers' fair market value (up to a maximum of twice the production costs).

The bill passed the House in September 1982, by a vote of 323–62, but it didn't fare as well in the Senate. Sen. John Danforth (R-Missouri), who had sponsored the companion bill in the Senate, tried to augment the Reagan Administration's lukewarm support of the legislation. But the Senate Finance Committee removed from the House version the legal waiver that would have freed Apple and other computer companies from the U.S. Court of Claims ruling (Singer Company vs. the United States) preventing companies from getting tax deductions on any hardware donated for promotional reasons. Senators Robert Dole (R-Kansas) and Metzenbaum were wary of the bill, not wishing to give Apple Computer Inc.—which has gotten off to an early lead in the educational market—an unfair advantage over its rival vendors.

But the final nail in the coffin had to do with money: by seeking to amend the tax code, the Apple Bill would have cost the U.S. Treasury approximately $15 million in lost tax revenues during the 1983 fiscal year. "This back-door approach—trying to change the tax code rather than opting for the traditional grant method—was employed because the attitude on the Hill in '82 did not favor grants," says John Jonas, a House Ways and Means Committee staffer who helped shepherd the bill through the House. "Then, of course, the stumbling block was the loss of tax revenue. As for this session, I think Rep. Stark is perfectly willing to support a grant program if the tax-code strategy again encounters rough sledding."

The state of California already has passed a law very similar to the first incarnation of the Stark bill. The maximum deduction per donated machine is about twice the production cost, and there's no limit on the number of computers a vendor can give away. "Our focus now is on the California program," says Apple Computer's David Beaver, an assistant to Steve Jobs. "It's our goal to give one computer to every public school in California in 1983. We hope that our California program will be so successful that we'll be able to go back to Congress and say, 'Look, it's working out very well in California. The kids have really learned a lot. Why don't you let us do this nationwide?'"

Beverly Hills Computer Store: The Limousine Treatment

BEVERLY
HILLS
COMPUTER
STORE

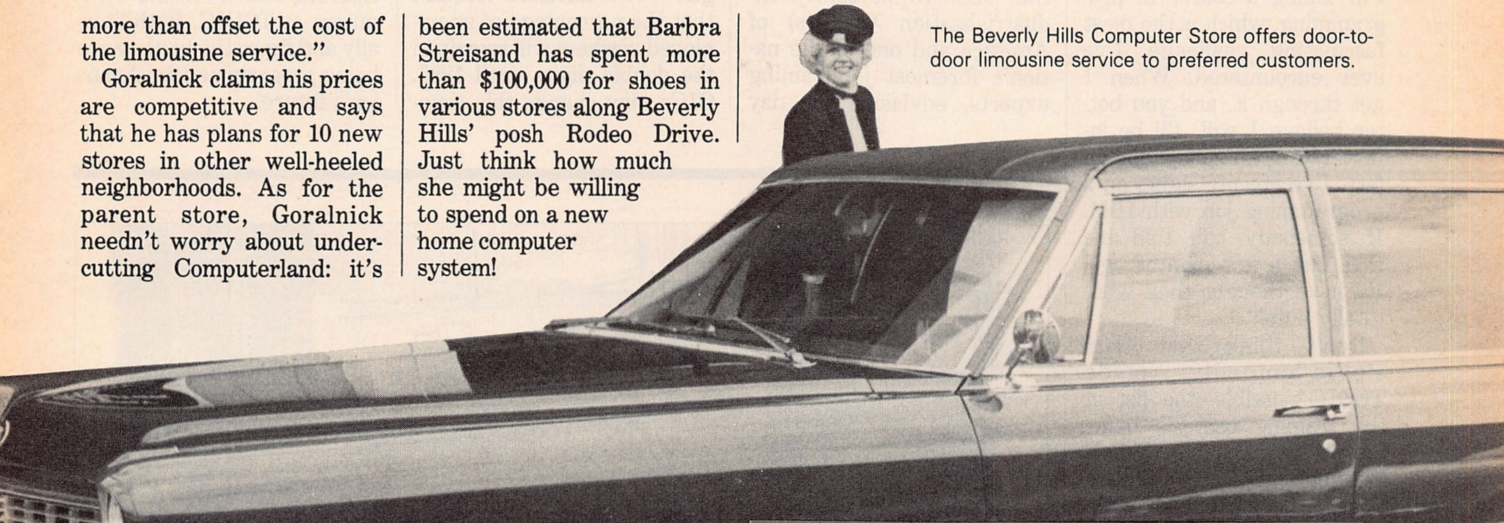
As a general rule, Beverly Hills superstars don't want to bump shoulders with the masses in computer stores. Murray Goralnick understands this perfectly, having resided in the privileged enclave for the past 15 years. That's why he opened the Beverly Hills Computer Store, which offers an array of red-carpet services.

Since 1970 Goralnick has headed a computer consulting firm and service bureau, both of which focus on mainframes rather than microcomputers. "Because I was in the computing field, though, my neighbors would bend my ear about the lousy treatment they were getting in computer stores," Goralnick recounts. "The salespeople at these stores would really intimidate their affluent customers. They'd expect them to shell out $5000 for some strange hardware in boxes that the customers would have to cart home and assemble themselves.

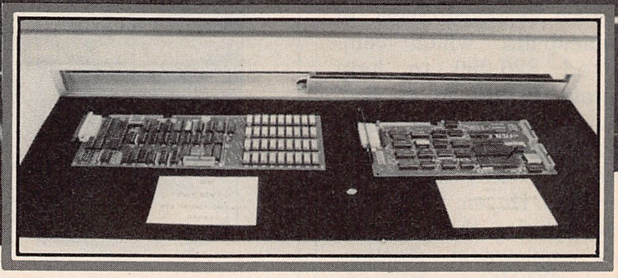
"I suddenly seized upon the idea of opening a computer store that emulates a jewelry store," Goralnick explains. "All the products are displayed on black velvet—even things like Z80 boards. It's really irritating to walk into a conventional computer store and see boards and peripherals with no price tags or explanations. We have prices and product descriptions displayed openly, and the black velvet telegraphs the message that spending $4,000 or $5000 isn't so silly after all."

Goralnick's Beverly Hills Computer Store—which sells only Apple, Zenith, and Fortune computers—lends new meaning to the term "hand-holding." "We have a chauffeured limousine on call that will take the customer and a store technician to the customer's home to set up the system," says Goralnick. "We feel that because of the type of service we render, we're going to have customer loyalty creating an aftermarket for software and peripherals that will more than offset the cost of the limousine service.”

Goralnick claims his prices are competitive and says that he has plans for 10 new stores in other well-heeled neighborhoods. As for the parent store, Goralnick needn't worry about undercutting Computerland: it's been estimated that Barbra Streisand has spent more than $100,000 for shoes in various stores along Beverly Hills' posh Rodeo Drive. Just think how much she might be willing to spend on a new home computer system!



The Beverly Hills Computer Store offers door-to-door limousine service to preferred customers.



All software at The Beverly Hills Computer Store is displayed in illuminated glass cases like fine jewels.

Free Computer Training for the Jobless

“The dream of offering free computer training was once considered to be rather off the wall. But today, we're making it work!”

That statement is uttered with more than a touch of jubilation by Duke Hamilton, executive director of the first tuition-free training center for word and data processing in the Minneapolis-St. Paul metropolitan area. The new school's name is a dandy—Twin Cities Opportunities Industrialization Center (TCOIC for short). But its purpose is simplicity itself: to offer computer-operating and programming training at no cost to those who qualify. The main qualification one must meet is to be unemployed.

Not at all surprisingly, the waiting list for enrollment is quite long. “This is the best thing I've ever done in my life,” states Irv Washington, one of the lucky students. “I've never even been near computers before. I think I'm falling in love!”

Turning the TCOIC dream of free computer training into a reality has been a joint project of many individuals, businesses, and computer firms, most notably IBM. Two TCOIC instructors on leave from IBM are Earl Bailey (computer-operating instructor) and Evelyn Galloway (computer-programming instructor).

IBM has not left Galloway and Bailey to fend for themselves. Surrounded by an impressive array of state-of-the-art computer equipment at TCOIC's north Minneapolis facility, they and their fellow instructors boast of more up-to-date hardware, software, and firmware than is found at many costly vocational/technical institutes. “Our students are getting the most modern computer training available anywhere,” states Galloway.

The IBM Personal Computer is central to TCOIC's training programs. “We feel that the students benefit most from hands-on experience with a variety of data-processing and word-processing equipment,” explains Bailey. “TCOIC students are fortunate indeed, and they know it.”

One such student is Matt Rivers, formerly of the Blue Earth Indian Reservation. When Matt came to Minneapolis in 1981 to live with his sister and her family, he encountered, among other of the big city's eye-openers, the specter of unemployment. “I worked at odd jobs—day labor and the like," Matt recalls. "I was getting nowhere with lightning speed. So when TCOIC opened its doors, I was one of the first to apply. Now I'm taking a course in programming, which is the most fascinating challenge I've ever encountered. When I get through it, and you better believe I will, I'll be infinitely more employable. In fact, I've got my sights on a programming job with IBM. If somebody had told me that just a few months ago, I'd have thought they were totally nuts!"

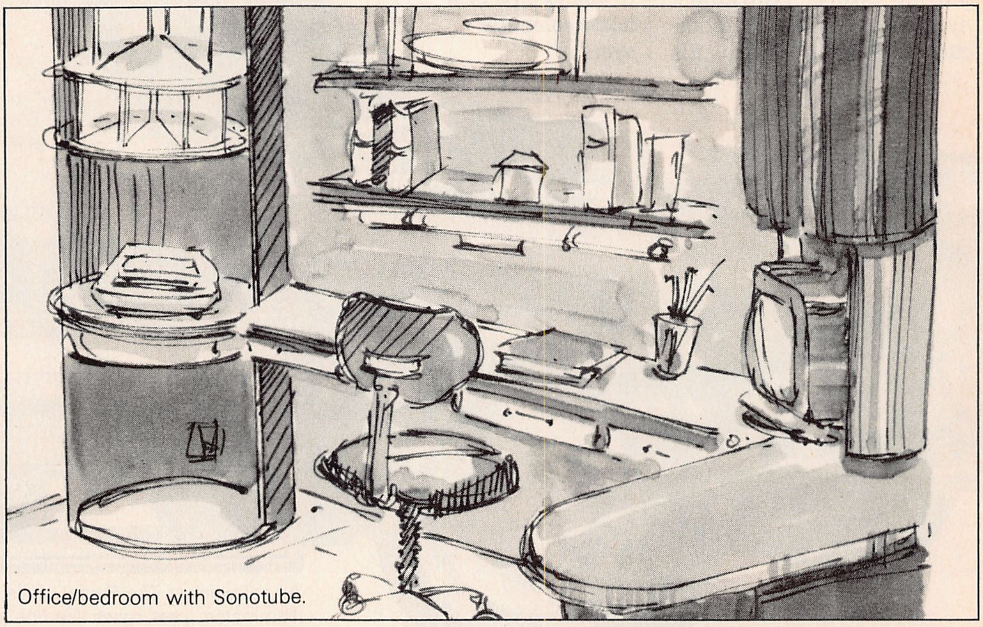
Don't think that IBM single-handedly made TCOIC possible—the list of the training center's benefactors reads like a Who's Who of Twin Cities corporations. Among them is Northwestern National Bank of Minneapolis, which committed $20,000 to help operate TCOIC in its first year. "We feel it's an excellent investment any way you slice it," notes the bank's Gerald L. Heyen. "Anything that benefits the community's employment situation, which TCOIC is doing, is most definitely good for our own business."

John Doyle, social policy and programs officer at Northwestern National, concurs. "I only wish," Doyle states wistfully, "that there had been something like TCOIC during *my* school days."

Because the unemployment rate is especially high among minorities, these groups are strongly represented in TCOIC's student body. "It may sound a bit trite," confides computer-programming student Trudy Williams, "but this center is nothing less than a new lease on life for many of us. I, for one, simply couldn't afford to go to school, but here I am. My TCOIC training is turning my whole life around. And you know what? It's a lot of fun."

It may not be long before other free computer training centers similar to TCOIC begin showing up in other areas of the country. Dr. Leon Sullivan, founder of the OICs (Opportunity Industrialization Centers) of America and one of the nation's foremost job-training experts, envisions the day when such centers will be found just about everywhere. "Heaven knows our nation needs them," Sullivan observes, "especially in this age of chronically high unemployment."

Some of President Reagan's own advisers forecast that the percentage of unemployed workers will remain in the double digits until 1985. OICs may change this timetable, however, thanks to IBM, Northwestern National Bank, and many other progressive corporations, and thanks especially to students who are eager to tool up for tomorrow. It would be difficult to find busier hardware than the IBM Personal Computers at TCOIC. Both literally and figuratively, they are being programmed for America's future.



Office/bedroom with Sonotube.

Micros to Match Decor

You've brought the new computer of your choice home from the store and are eager to get it running, but if you're like most new owners you haven't given a second thought to where you're going to set up all this new electronic gear. If you live in a house with an extra room, you're lucky, but what do you do if you live in an apartment that has little unused space?

Don't despair. A civilization that can put a computer in the home can design a convenient and attractive place to keep it. In fact, the American Society of Interior Designers (ASID) in New York provides the names of members who have experience in arranging stylish quarters for computers.

At John Saladino's, for instance, a spokesperson said, "Most of our clients are bankers or commodity dealers who are proud of their computers, so we decorate around equipment that is right out in the open."

Today, personal computers for young people are in much the same demand as electric trains or dollhouses were years ago. For the child who receives a computer but has little room for it, designer Joan Wolf suggests a Formica table on casters that can be rolled into a closet in the child's bedroom when the computer is disconnected.

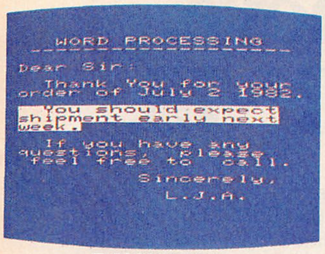
Many designers also prefer rugged and colorful laminates like Formica for computer work surfaces used by adults. At Bernita Interiors, designers use such materials to create unobtrusive tables that blend in line and color with existing decors. These tables can be integrated with shelves housing home entertainment equipment or even hidden behind folding doors when not in use.

"Form and function are most important in home design today," say the Bernita designers, who help clients achieve an eclectic look by encouraging a mix of high-technology equipment with antiques or family heirlooms.

A man, a woman, and a

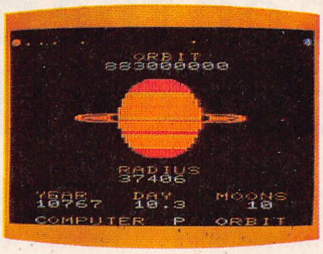
CONTINUED ON PAGE 26

IF YOU OWN A COMMODORE COMPUTER, YOU KNOW IT CAN DO ALL THIS.



```
WORD PROCESSING
-------------------
Dear Sir:
  Thank You for your
order of July 2 1982.
  You should expect
shipment early next
week.
  If you have any
questions, please
 feel free to call.
         Sincerely,
            L.J.A.
```

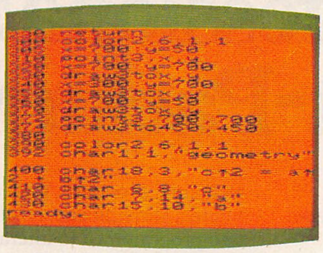
BUSINESS



```
          ORBIT
        883000000

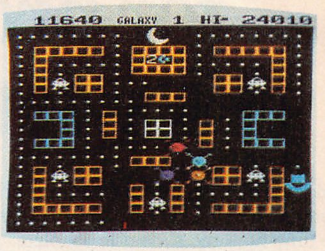
          RADIUS
          37406
  YEAR       DAY      MOONS
  10767      10.3       10
  COMPUTER   P    ORBIT
```

EDUCATION



```
[illegible] return
[illegible] color2,6,1,1
[illegible] x=700:y=50
[illegible] point3,x,y
[illegible] x=700:y=700
[illegible] draw3tox,y
[illegible] x=300:y=700
[illegible] draw3tox,y
[illegible] x=700:y=50
[illegible] draw3tox,y
[illegible] point3,700,700
[illegible] draw3to450,450
[illegible]
390 color2,6,1,1
392 char1,1,"geometry"
400 char18,3,"c↑2 = a↑
2 + b↑2"
410 char 6,8,"c"
420 char 7,14,"a"
430 char15,10,"b"
ready.
```

PROGRAMMING



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11640 GALAXY 1 HI- 24010
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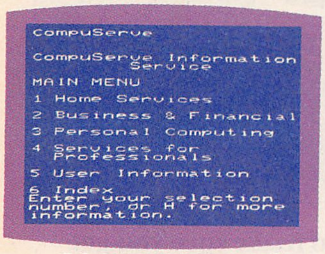
GAMES

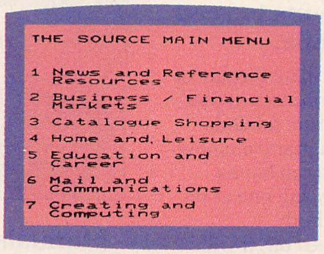
BUT DID YOU KNOW FOR ABOUT $100, YOU CAN ALSO GET IT TO DO ALL THIS?



```
CompuServe

CompuServe Information
         Service
MAIN MENU
1 Home Services
2 Business & Financial
3 Personal Computing
4 Services for
  Professionals
5 User Information
6 Index
Enter your selection
number, or H for more
information.
```

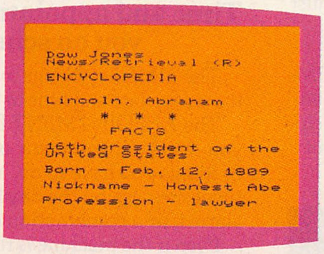
COMPU SERVE™



```
THE SOURCE MAIN MENU

1 News and Reference
  Resources
2 Business / Financial
  Markets
3 Catalogue Shopping
4 Home and Leisure
5 Education and
  Career
6 Mail and
  Communications
7 Creating and
  Computing
```

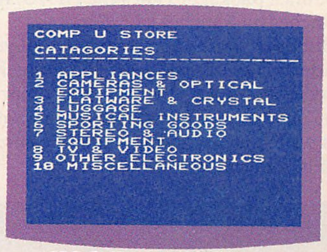
THE SOURCE℠



```
Dow Jones
News/Retrieval (R)
ENCYCLOPEDIA

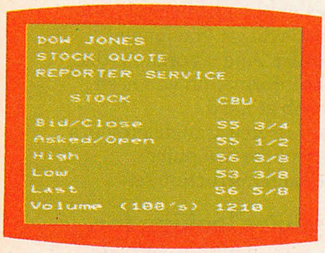
Lincoln, Abraham
     *   *   *
      FACTS
16th president of the
United States
Born - Feb. 12, 1809
Nickname - Honest Abe
Profession - lawyer
```

ENCYCLOPEDIA



```
COMP U STORE
CATAGORIES
-----------------------
1 APPLIANCES
2 CAMERAS & OPTICAL
  EQUIPMENT
3 FLATWARE & CRYSTAL
4 LUGGAGE
5 MUSICAL INSTRUMENTS
6 SPORTING GOODS
7 STEREO & AUDIO
  EQUIPMENT
8 TV & VIDEO
9 OTHER ELECTRONICS
10 MISCELLANEOUS
```

SHOP AT HOME

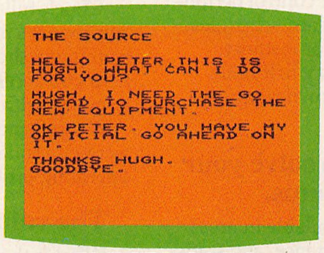


```
DOW JONES
STOCK QUOTE
REPORTER SERVICE

  STOCK              CBU

Bid/Close           55 3/4
Asked/Open          55 1/2
High                56 3/8
Low                 53 3/8
Last                56 5/8
Volume (100's)      1210
```

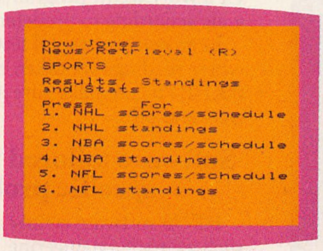
DOW JONES NEWS/RETRIEVAL®



```
THE SOURCE

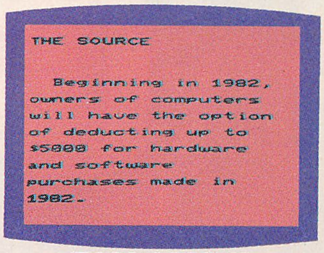
HELLO PETER THIS IS
HUGH. WHAT CAN I DO
FOR YOU?
HUGH, I NEED THE GO
AHEAD TO PURCHASE THE
NEW EQUIPMENT.
OK PETER. YOU HAVE MY
OFFICIAL GO AHEAD ON
IT.
THANKS HUGH.
GOODBYE.
```

ELECTRONIC MAIL



```
Dow Jones
News/Retrieval (R)
SPORTS
Results, Standings
and Stats
Press    For
1. NHL scores/schedule
2. NHL standings
3. NBA scores/schedule
4. NBA standings
5. NFL scores/schedule
6. NFL standings
```

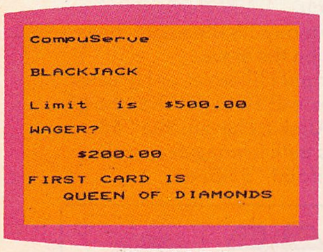
WIRE SERVICE NEWS



```
THE SOURCE


  Beginning in 1982,
owners of computers
will have the option
of deducting up to
$5000 for hardware
and software
purchases made in
1982.
```

TAX ADVICE



```
CompuServe

BLACKJACK

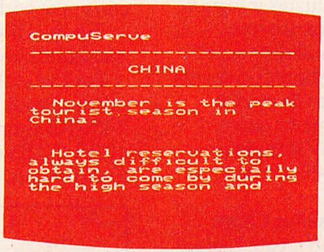
Limit is $500.00

WAGER?

    $200.00

FIRST CARD IS
   QUEEN OF DIAMONDS
```

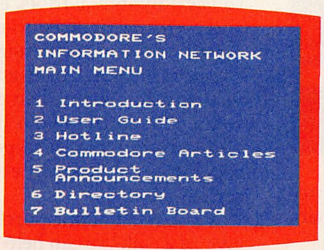
GAMES



```
CompuServe
---------------------------
          CHINA
---------------------------
  November is the peak
tourist season in
China.

  Hotel reservations,
always difficult to
obtain, are especially
hard to come by during
the high season and
```

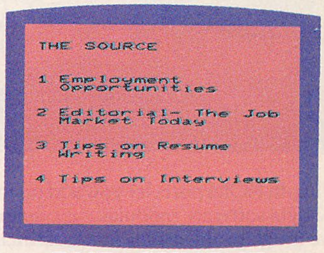
TRAVEL INFORMATION



```
COMMODORE'S
INFORMATION NETWORK
MAIN MENU

1 Introduction
2 User Guide
3 Hotline
4 Commodore Articles
5 Product
  Announcements
6 Directory
7 Bulletin Board
```

COMMODORE INFO. NETWORK



```
THE SOURCE

1 Employment
  Opportunities

2 Editorial- The Job
  Market Today

3 Tips on Resume
  Writing

4 Tips on Interviews
```

EMPLOYMENT OPPORTUNITIES

The screens at the top of the page show a few examples of how versatile the VIC 20™ or Commodore 64™ can be with the addition of Commodore software.

The screens below them give you a few examples of how much more versatile they can be with the addition of a Commodore VICMODEM.

For around $100, the Commodore VICMODEM will turn your VIC 20 or Commodore 64 computer into a telecomputer.

To make matters even better, Commodore includes a few little extras (such as a free hour's time on the two most popular telecomputing services) that add up to a value of $197.50.* A nice return on an investment of about $100.

Most computer companies think it's reasonable to ask as much as $500 for a modem that'll give you telecomputing capabilities such as ours.

However, with a VICMODEM priced at around $100, we think we're being a lot more reasonable. Don't you agree?

commodore
COMPUTER

U.S.A.–P.O. Box 500, Conshohocken, PA 19428; Canada– 3370 Pharmacy Avenue, Agincourt, Ontario, Canada M1W 2K4. * Certain offers subject to change.
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Circle 20 on inquiry card.

Introducing the portable computer for professionals on the move. Hewlett-Packard's new HP-75.

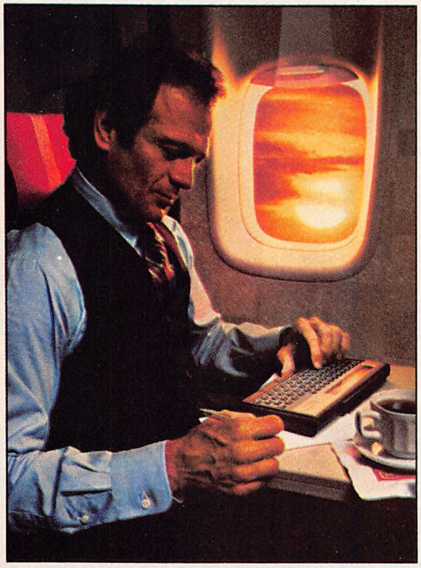
A decade ago, we introduced the world's first scientific pocket calculator and rendered the time-honored slide rule obsolete.

Now we're introducing the HP-75 portable computer. And if press reaction is any indication, history is about to repeat itself.

As small as a book. As powerful as a personal.

Desktop-computer power in a handsome 26-ounce package. That's the HP-75. It's just 10 inches by 5 inches by 1¼ inches.

But don't let the compactness fool you. Inside its rugged case lies a 48K-byte, ROM-based operating system. With a comprehensive, 147-command instruction set that helps you write hard-working, memory-efficient BASIC programs.



Plug-in ROM ports let you add up to three 32K-byte software modules—modules that solve tough problems *without* sacrificing user memory.

And that user memory gives you up to 24K bytes of program and data storage.

It all adds up. A fully loaded HP-75 is a 168K-byte computing powerhouse in calculator clothing.

Want more? A built-in magnetic card reader provides a convenient, inexpensive way to store and retrieve programs or data.

The HP-75's typewriter-like keyboard means rapid, accurate entry of text or data. And when we say you can touch type on it, we *mean* you can touch type on it.

Those keys, by the way, can be redefined with your favorite commands or programs. Up to 196 unique key combinations in all.

Immediate, convenient access to your most frequently used programs.

Thanks to the HP-75's multiple-file structure, programs, data and text can be named, simultaneously stored in memory, and programmed to interact with each other.

Add continuous memory, and you've got a computer that's designed to solve problems on the go. Simply load your favorite files and enjoy immediate access to any or all of them. The files are retained in memory until *you* decide to delete them—even when the machine is turned off.

Time and appointments to keep you on schedule.

The TIME key brings to display the day of the week, date and time to the nearest second.

The APPOINTMENT feature reminds you—an hour from now or a year from now—of things you have to do. You can have a silent message on the display, any one of six alarms, or a combination of both.

Even if the machine is turned off, it will "wake up" and alert you of an appointment. Or it will execute programs or control peripherals according to predetermined schedules.

In an environmental test, for instance, where readings are taken every half hour, the HP-75 can make sure its owner gets the weekend off.

Software tailored to solve your specific problems.

HP-75 software is now available in areas such as math, engineering, finance, and statistics. With VisiCalc®* on the way.

Our plug-in math module,* for instance, solves polynomial roots, evaluates integrals, and performs finite Fourier transforms.

With our text-formatter module,** you'll compose memos, letters, and short documents virtually anywhere; then print them out when you return to your home or office.

In addition, our third-party software program assures you of ever-expanding software variety.

If you're a volume purchaser or OEM, give us a call. We can help you create custom HP-75 systems with special plug-in modules, magnetic cards, digital cassettes, and keyboard overlays.

Peripherals for a total computing package.

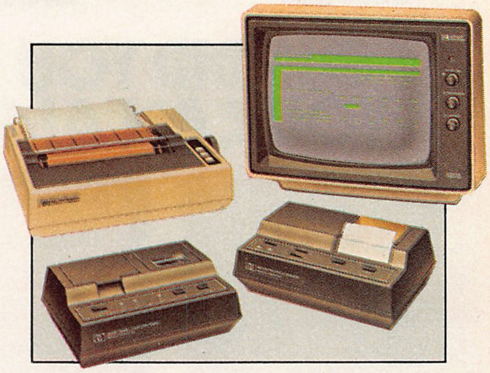
The HP-75 is equipped with the Hewlett-Packard Interface Loop, giving you a choice of 15 peripherals. (And that choice is expanding. The HP-75 *can* work simultaneously with up to 30.)

In a battery-powered briefcase system weighing about seven pounds, you might have the 24-character printer, digital cassette drive and acoustic modem.***

A desktop system might include the 80-column impact printer, full-color graphics plotter, and 12-inch video monitor.

And the HP-75 can "talk to" other computers, peripherals, and instruments with our HP-IB (IEEE-488),** RS-232,* and GPIO interfaces.

In summary, the HP-75 is the heart of an extremely versatile system, in addition to its stand-alone capabilities.



Manuals to make sure you get the most from your machine.

Chock-full of examples and helpful hints, our owner's manual will get you up and running in short order. And it's organized to help you access the information you need to get on with the job at hand.

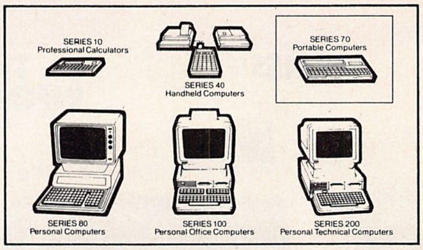
A supplementary reference guide provides a concise summary of the computer's operating protocol and instruction set.

The value you're looking for.

What is the price of all this power in this compact package? $995.**** A lot less than you might pay for a personal computer you can't take with you.

See the HP-75 today. It's the smart choice for professionals on the move.

For the authorized HP dealer or HP sales office nearest you, call TOLL-FREE 800-547-3400 (Oregon, Alaska, Hawaii: 503-758-1010). *TTY users with hearing or speech impairments, dial 503-758-5566.*



*Available May 1, 1983.

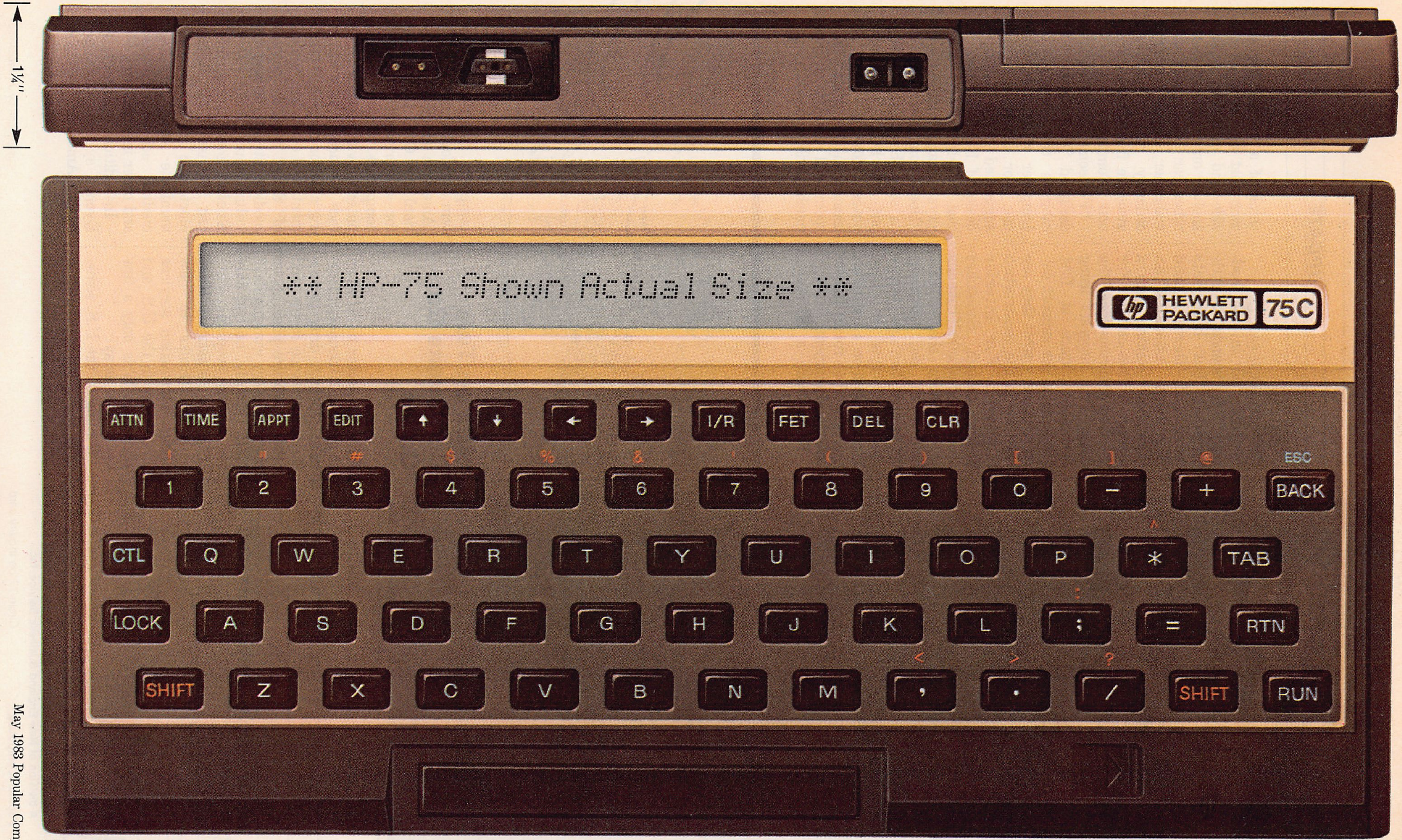
**Available March 1, 1983.

***Call our toll-free number for availability.

****Suggested retail price. May vary outside U.S. Peripherals and software not included.

VisiCalc® is a registered trademark of VISICORP.

HEWLETT PACKARD



HP-75 SPECIFICATIONS

Size and weight: 10" X 5" X 1¼," 26 oz.
48K-byte, ROM-based operating system:
• 8-bit CMOS CPU • Multiple file structure in continuous memory • Instruction set: 52 system commands, 43 BASIC commands, 41 numeric functions, 7 string functions, 6 time-mode commands, 16 arithmetic/logical/relational operators
Numeric precision:
• Real—12 digits (±9.99999999999 x $10^{\pm 499}$)
• Short—5 digits (±9.9999 x $10^{\pm 99}$)
• Integer—5 digits (±99999)
Time/appointments:
• Perpetual clock/calendar • 12- or 24-hour format • Appointment control of command/program execution
Memory:
• User (RAM)—16K bytes, expandable to 24K bytes • Operating system (ROM)—48K bytes
• Plug-in software (ROM)—up to 96K bytes (3 32K-byte modules)
Typewriter-like QWERTY keyboard:
• 65 keys • 194 redefinable key combinations
• "Hidden" numeric keypad
Integral mass storage: hand-pulled card reader (1.3K bytes per card)
Built-in interface: HP-IL; choice of 15 peripherals
Power supply: 3 AA NiCad batteries (AC adapter/charger included)
Liquid-crystal display: 32-character window on 96-character line

PG02308 608 C

56page FREE catalog

Business Forms and Supplies for MICRO Computers

Save money. Your firm name and address printed on standardized, continuous checks, invoices, statements, letterheads and labels.

Designed to work with programs from over 200 software sources . . . or program to our attractive forms yourself with guides provided.

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Fast service . . . buy direct by mail or
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NAME PHONE
COMPANY
STREET
CITY, STATE and ZIP

Required to help us send you correct information:

SOFTWARE BRAND PACKAGE# ☐ Do own programming.
COMPUTER MAKE MODEL# ☐ Have not purchased yet.
YOUR LINE OF BUSINESS Number of employees.

28104

Nebs Computer Forms
12 South Street, Townsend, Massachusetts 01469
A division of New England Business Service, Inc.

Circle 77 on inquiry card.

CONTINUED FROM PAGE 22

computer all in one bedroom? It sounds a little crowded, but blueprints from JSI Designs and Regenbogen Associates Inc. show how exciting such a ménage à trois can be. For the bedroom-cum-office, the design firm suggests using Sonotubes, which at first glance look like support columns (exactly what they are used for in the construction industry). For interior design, though, Sonotubes are formed into half-columns with custom shelves that hold a TV set, computer, typewriter, bar, and storage space for tapes or disks. When placed on a turntable, the Sonotubes rotate to conceal the equipment.

To visualize a Sonotube, think of a freestanding column that is curved on one side and opens to built-in shelves on the other. Sonotubes can be covered with wallpaper, carpet, fabric, or ordinary paint. They are available from Sonoco Products Company.

"For some clients we have designed 7-foot desks with cabinets that conceal the computer when it's not in use. For others, we have suggested huge L-shaped desks of Formica Colorcore that 'landscape' a room," says Joan Regenbogen. "Home computers are here to stay. Eventually, everyone will live with a computer. How it is to be treated in the design of a room will depend on how much it will be used."

MDs on Two Continents Go Online

What's a doctor to do when as much as 20 pounds of journals, reprints, drug promotions, insurance forms, and other literature piles up on his desk every working day? Until recently, he had only two choices: keep up-to-date or tend to his patients. Now, however, thanks to new online information services for doctors in the U.S. and abroad, help is only a few keystrokes away.

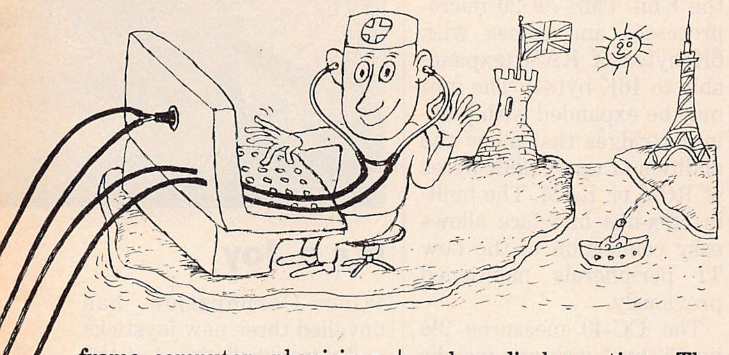
Coming to the U.S. sometime this year is Amnet, a computer information system developed by the AMA (American Medical Association) and GTE Corporation for doctors with personal computers. Any microcomputer with an RS-232C interface can access data including aids for diagnosis, treatment, and education, notices of drug recalls, copious medical literature, and the voluminous AMA *Drug Evaluations*. Subscribers can also use GTE Telenet electronic mail to communicate with hospitals, medical schools, libraries, and other institutions.

In addition to Amnet, the Eyenet system, developed by the American Society of

Illustration by Jo Teodorescu

Contemporary Ophthalmology, should be available to American doctors this year. Eyenet gives instant information via computer about ophthalmic drugs, lenses, instruments, and clinical procedures.

In England, Professor Paul Grob at the University of Surrey at Guildford has organized four databases for Prestel, the world's largest viewdata system. Linked to the university's Prime mainframe computer, physicians with microcomputers can electronically keep abreast of important updates in medicine.



During an 18-month study to ascertain whether doctors would supply data, 50 trial users responded enthusiastically. The system went online over Prestel last August.

Pilot use of electronic mail by doctors to report adverse reactions to drugs began in Britain last November. There has long been a system of mailing yellow cards, but many physicians seldom got around to using it. Aside from greater speed of reporting, compilation of results is simpler and more accurate. Microcomputers have also improved the paper-based mail system whereby 120 group practices that serve half a million patients report the incidence of 40 acute diseases, tracing the ebb and flow of epidemics across the United Kingdom.

For some time British doctors and hospitals have been able to access poison control centers through the closed-user Incotel system. By the middle of this year, the centers should be accessible on Prestel so that even nonprofessionals can get emergency facts on what antidotes can counteract the effects of fast-acting poisons.

Britain's Department of Industry (DOI) announced last fall that it would "finance the major part of the purchase, installation, and maintenance costs for three years" of 150 microcomputers in selected general medical practices. The government agency pays half the cost of hardware and software, anywhere from about $5000 for the solo practitioner to perhaps $12,000 for a large group practice. As the DOI puts it, "Assuming income tax at the rate of 50 percent for all partners, the net costs to your practice could be about £1500 to £3500 [the British pound was then $1.67]; leasing arrangements could also soften the blow." In total, the British government plans to invest more than $4 million in equipping general practitioners with microcomputers.

In France, the Diagnostic Medical Aids system has been online with a reported 160 terminals since September 1981. The database is in Rennes, three hours west of Paris by train. On tap are 15,000 symptoms used to help identify 2200 illnesses. Each terminal has a printer for users to make hard copies after browsing on their monitors. The diagnostic system is a closed-user group linked to Teletel, the French two-way viewdata system. □

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Requirements: CP/M-80, CP/M-86, IBM PC-DOS (MS-DOS); 64K RAM; Addressable cursor terminal; Printer capable of 132 column.

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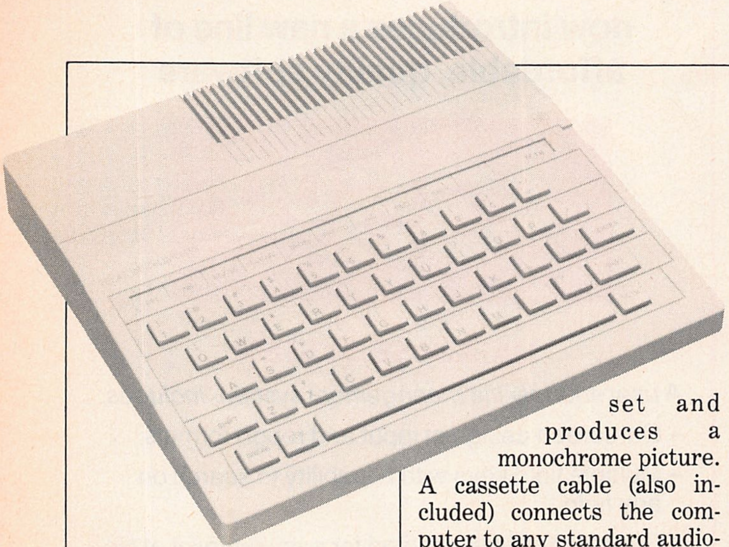
Circle 91 on inquiry card.



Two More Low-Cost Computers from TI

Texas Instruments Inc. has announced a low-cost home computer, a portable computer, and a variety of peripherals.

The TI-99/2 learning computer (above) is priced under $100 and features a 48-key keyboard, a slot for plug-in software cartridges, and a standard interface for new peripherals from TI. The company expects the unit to to be used by hobbyists, engineers, students, and others wishing to experiment with computers.

The TI-99/2 is based on the TMS-9995 16-bit microprocessor, similar to the chip used in the TI-99/4A. The new computer comes with 4.2K bytes of random-access memory (RAM) that is internally expandable to 36.2K bytes. The TI BASIC programming language is permanently stored in read-only memory (ROM).

The computer console connects via the provided switchbox to any television set and produces a monochrome picture. A cassette cable (also included) connects the computer to any standard audio-cassette recorder for storage of programs and data.

The 99/2 uses TI's new intelligent Hex-bus interface to connect to the HX-1000 four-color printer/plotter ($199.95), HX-2000 Wafer-tape digital tape drive unit ($139.95), HX-3000 RS-232C serial interface ($99.95), and other peripherals.

TI's Compact Computer and three new peripherals.

TI's other offering is the Compact Computer 40 (CC-40), a portable unit with a 65-key keyboard and built-in liquid-crystal display (LCD). The battery-powered computer is programmable in an enhanced form of BASIC and can run preprogrammed applications software loaded from either plug-in cartridges or miniature tape cassettes. With a suggested retail price of $249.95, the CC-40 is designed for use in professional, technical, and personal applications.

The computer is based on the 8-bit TMS-70C20 microprocessor and comes with 6K bytes of RAM (expandable to 16K bytes). The unit may be expanded with plug-in cartridges that allow the addition of up to 128K bytes of ROM or RAM. The built-in Hex-bus interface allows easy connection to the new TI peripherals mentioned previously.

The CC-40 measures 9½ by 5¾ by 1 inch and weighs just 22 ounces. Its 31-column single-line LCD displays both uppercase and lowercase characters. It also includes 18 status indicators for items such as shift key, control key, function key, degrees/radians/grads mode, input/output in progress, error, low battery, and horizontal-scroll mode.

Four AA alkaline batteries provide up to 200 hours of use. The unit may also be connected to a standard 115-volt AC power outlet via the optional AC adapter ($14.95).

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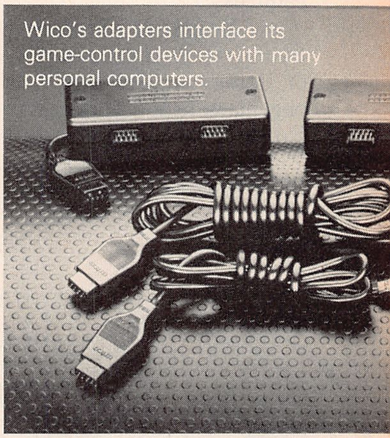


Wico's adapters interface its game-control devices with many personal computers.

It's a Joy

Wico Corporation has unveiled three new joysticks and a trackball aimed at the home computer market.

The Joystick ($29.95) game control features a bat-handle grip, two fire buttons, eight-position movement, and a six-leaf assembly. Compatible with all Atari and Commodore units, it comes with a one-year warranty.

The Redball Joystick ($34.95) includes all of the features found on the Joystick as well as the same red ball control handle found on many arcade machines. The Redball Joystick is compatible with all Atari and Commodore computers.

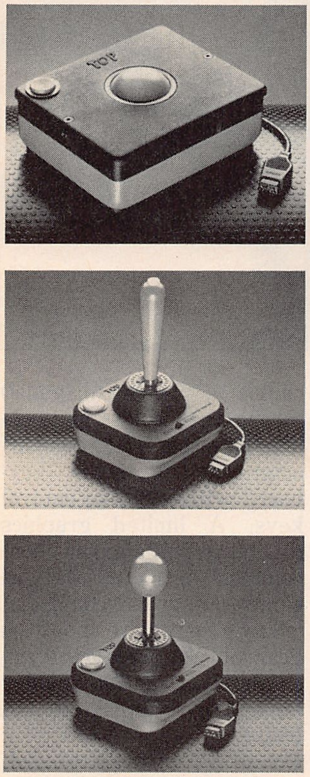
Joystick Deluxe ($39.95) is Wico's top-of-the-line joystick. Compatible with all Atari and Commodore computers, Joystick Deluxe boasts rugged, heavy-duty contruction, a two-position slide switch for one- or two-hand response, and a bat-handle grip.

Trackball ($69.95) employs the same 360-degree ball movement found on arcade games, giving the user complete game control and a degree of flexibility not possible with conventional joysticks. Trackball is available in versions for Atari,

Commodore, Radio Shack, Texas Instruments, and Apple computers.

For further details on these units, write Wico Corporation, 6400 West Gross Point Rd., Niles, IL 60648.
Circle 201 on inquiry card.

Wico's game controllers include a trackball, standard joystick, and Redball joystick.



Micro to Mainframe

Apple Computer Inc. has announced a package that enables Apple computers to communicate with IBM mainframe computers.

The device, a 3270 cluster-controller emulator, allows Apple computers to emulate IBM terminal functions. Executives, data-processing professionals, and others can use Apple computers at their desks to take advantage of such mainframe capabilities as online data entry, electronic mail, and remote database access.

The emulator package is available both in a system network architecture/synchronous data link control (SNA/SDLC) version as well as in a binary synchronous communication (BSC) version. The unit will support as many as seven directly connected Apple computers or an even larger number of Apples connected via modems. Printers can be connected either to the emulator directly or to one or more of the Apple computers.

Further details and prices are available from Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014.
Circle 202 on inquiry card.

Don't Get Angry, Get Mad

The MAD-1 is a 16-bit computer featuring an Intel 80186, 16K bytes of read-only memory, 128K bytes of random-access memory, an 85-key detached keyboard, one parallel port, two serial ports, three-part modular construction, and a variety of floppy-disk and hard-disk drive configurations.

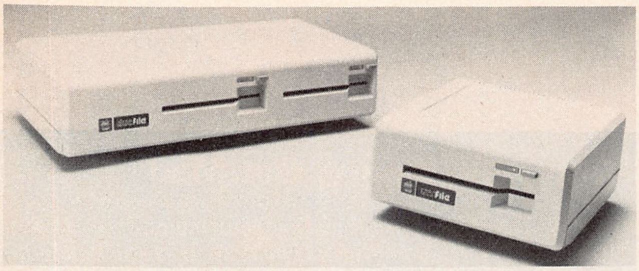
With system prices ranging between $3000 and $6000, the MAD-1 offers a variety of operating systems, languages, and applications programs. Included among these are Microsoft's MS-DOS and Digital Research's Concurrent CP/M-86; Microsoft BASIC, COBOL, FORTRAN 77, and Pascal; Madplan, Madwrite, and Madaccount.

For further details, contact Mad Computer, Building 13, 3350 Scott Blvd., Santa Clara, CA 95051.
Circle 203 on inquiry card.

Apple III Disk Drives

Two new high-density floppy-disk drives for the Apple III are now available from Apple Computer Inc. The Unifile and Duofile drives both provide 871,424 bytes of online storage. They serve the needs of professionals, software developers, managers of small to medium-sized businesses, and others who need mass storage for applications such as accounting and database management. Unifile and Duofile complement the Apple III's built-in 140K-byte Disk III floppy-disk drive as well as the 5-megabyte Profile hard-disk system.

Unifile is designed to serve as a backup for Profile, allowing the user to transfer onto 6 disks information that would fill 35 ordinary floppy disks. A new software utility called Backup III simplifies the process by selectively backing up and restoring



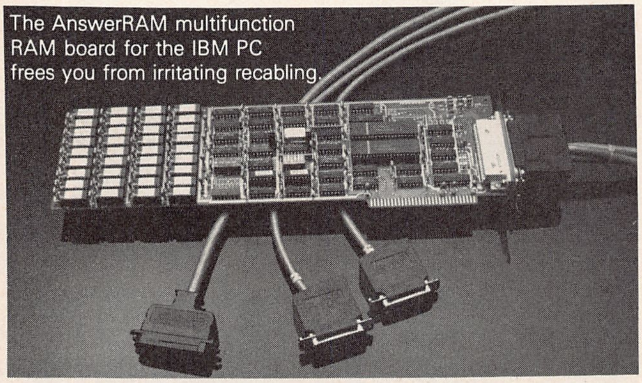
Apple's new high-density floppy-disk drives.

Profile's files.

Duofile provides Apple III users with an additional mass storage alternative. It contains two of the high-density disk drives for a total capacity of 1742K bytes. These new floppy-disk drives offer greater data security than hard-disk drives because their disks are removable.

Both Unifile and Duofile use new disk-drive technology developed by Apple to achieve high density without losing reliability.

Unifile retails for under $1000, Duofile for under $1700. For more information, contact Apple Computer Inc., 20525 Mariani Ave., Cupertino, CA 95014.
Circle 204 on inquiry card.



The AnswerRAM multifunction RAM board for the IBM PC frees you from irritating recabling.

Versatile RAM Board for IBM PC

IBM Personal Computer users who plan business applications such as local networks, telecomputing, and sophisticated printing often encounter "the cabling crisis." Nobody likes to swap cables all day, but what can you do?

One solution is Anatron's new AnswerRAM, a multipurpose RAM board that gives the PC user two asynchronous serial communications ports and another parallel printer port. The three I/O ports come factory wired and ready to go—and that means no more recabling. AnswerRAM uses only one of the PC's expansion slots to support all communications and IBM-compatible memory.

The product comes with connectors for both serial and parallel interfaces (two heavy-duty DB-25 connectors for the RS-232C serial port and one heavy-duty connector for the parallel (Centronics) port), and a well-illustrated 26-page instruction manual. For more information, write Customer Support, Anatron Inc., 202 West Bennett, Saline, MI 48176.
Circle 205 on inquiry card.

Free Computer-Forms Catalog

A 36-page full-color catalog from Nebs Computer Forms lists the company's line of paper and accessories for word-processing applications. Featured are continuous Micro-Perf letterheads (which look like ordinary cut sheets after they are separated), continuous envelopes, and computer accessories such as floppy disks, print wheels, and workstation furniture.

The free catalog also includes a selection of personalized continuous checks, statements, invoices, and labels. All items are available in quantities as small as 500. A one-page reference guide to major software packages that are compatible with the forms is also provided.

For your copy of the catalog, write Nebs Computer Forms, 12 South St., Townsend, MA 01469.
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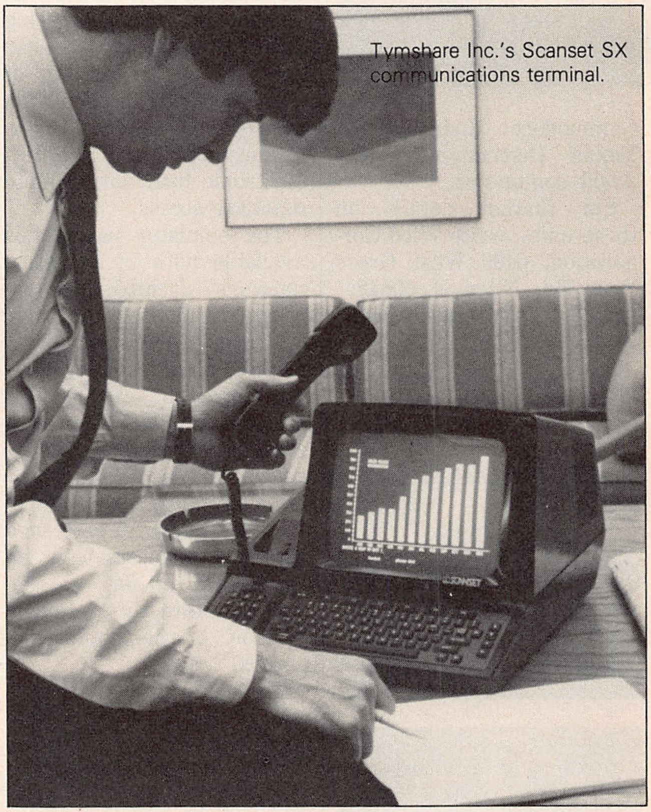

Tymshare Inc.'s Scanset SX communications terminal.

Terminal for Voice and Data

Priced at $895, the Scanset XL is a single unit that can handle both voice and data communications. Standard features include automatic dialing, automatic log-on, and a built-in directory that allows users to call any of the 36 prestored numbers with the touch of only one or two keys. The unit also includes a 9-inch (diagonal) screen that holds up to 24 lines of either 40 or 80 characters and a 69-key keyboard with 4 cursor-control keys. A limited graphics capability will support most common forms as well as simple line or bar graphs.

To find out more about the Scanset XL, contact Tymshare Inc., 20705 Valley Green Dr., Cupertino, CA 95014.
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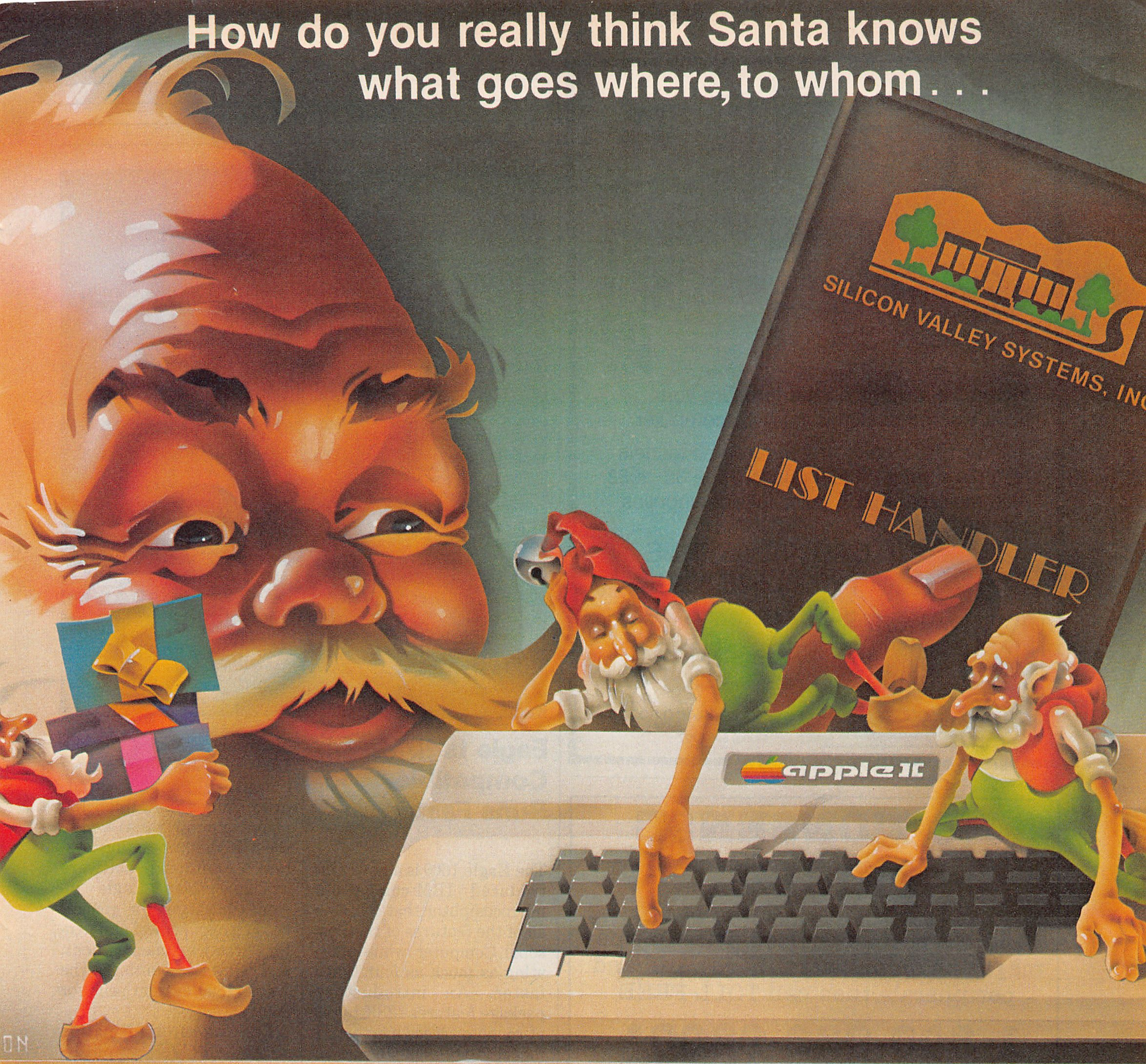
How do you really think Santa knows what goes where, to whom . . .



LIST HANDLER

The List Handler is, **without doubt**, much more than a mailmerge program.

Presto! List Handler turns your Apple® into a quick response file cabinet with room to grow storage space. **With List Handler you can hold up to 3000 records per drive so that 24000 can be kept on-line at the same time with multiple disk drives.**

These records can be addresses if you choose, but here's where the versatility and flexibility come in.

Put what you like on those records!

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The list is endless.

The List Handler will run on one or more drives, read and write DIF format and has unlimited sort fields.

List Handler can stand alone or as an interface with your Word Handler (or most other word processors) for the most efficient word processing duo around.

The List Handler will surprise you, but the first surprise will be the price! At 89.95 the List Handler is the best and the only buy of its type around.

The enormity of Santa's job may have you skeptical of Santa's existence—but when you see the List Handler you might just believe in Santa again! See your Apple dealer for the List Handler.

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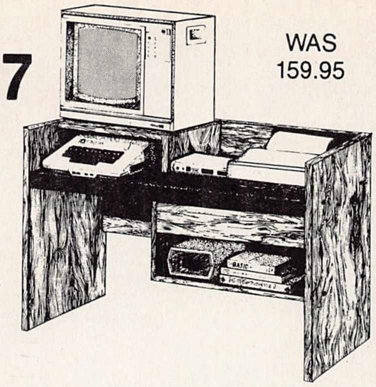

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The Eagle 1600 offers compatibility with the IBM Personal Computer.

Eagle Is IBM-Compatible, Runs Faster

The Eagle 1600 is a newly introduced IBM-compatible microcomputer that contains all of the features of the Personal Computer while operating as much as four times faster. An introductory package features 128K bytes of random-access memory, 1 megabyte of disk storage on a 5¼-inch floppy-disk drive, and 12.5 megabytes of hard-disk storage. The machine's internal memory is expandable to 512K bytes, and as many as eight IBM-compatible boards may be easily installed for such optional peripherals as printers, color monitors, and telecommunications devices.

The 1600 follows IBM's three-piece modular style with a detachable keyboard, separate monitor, and system unit. The 105-key keyboard includes 24 user-definable function keys. Users can select from a wide range of software that includes programs designed for the IBM PC. The 1600 comes complete with word-processing and financial-planning programs as well as the CP/M-86 operating system. Additional software available from Eagle includes packages for general accounting, medical and dental practice management, and CPA accounting. The Eagle 1600 system sells for $6995.

For more information write Eagle Computer, Building C, 983 University Ave., Los Gatos, CA 95030. **Circle 208 on inquiry card.**

Making Music by Computer

Roland Corporation, one of the famous names in the analog electronic music field, is now offering a computer-based system compatible with Apple II and NEC microcomputers. Compu Music CMU-800R is a combination hardware/software

Circle 70 on inquiry card.

"When I need words . . . I use The WORD HANDLER"

It speaks for itself!

The Word Handler is the easiest word processor around . . . also the most sophisticated. The Word Handler is a single-key command word processing program that runs without hardware modifications to your Apple®, or Apple compatible computer.

Words can't describe how much I love the Word Handler but let me tell you the Word Handler gives me unlimited tabs, incremental spacing, vertical spacing and a two character format. My Word Handler comes with a simple-to-understand manual, complete customer service and free, yes, **free** upgrades.

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The Word Handler's many print
features are displayed on the
screen so I can see at a glance
exactly what will be printed.
For example: underlining, bold
superscript, UPPER / lower case.
Even / normal justification.
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See your Apple, or Apple compatible computer dealer for sophisticated simplicity . . . The Word Handler.

Let it speak for you.

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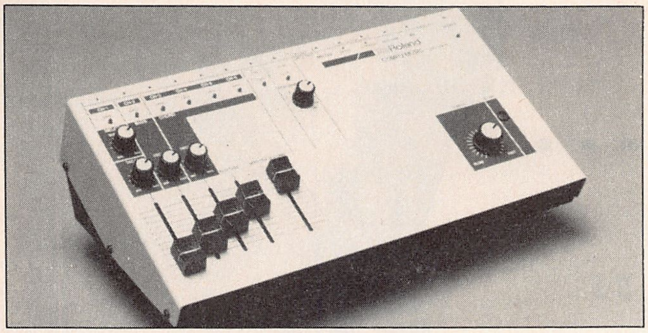

Roland Corporation's synthesizer gives your computer hi-fi capabilities.

system with six musical and seven percussive voices, variable tempos, and user-defined rise, sustain, and decay settings. The CMU-800R connects to any stereo system for audio playback and can be expanded into a much larger synthesizer system because it's based upon accepted synthesizer industry standards.

The CMU-800R operates by breaking down the basic musical elements (pitch, timing, and phrasing) into numeric equivalents. Music is entered note by note, then edited, arranged, played, and finally stored on disk. Music can be entered off conventional sheet music or from preprogrammed disks that Roland is making available.

Further details can be obtained from Rolandcorp US, 2401 Saybrook Ave., Los Angeles, CA 90040.

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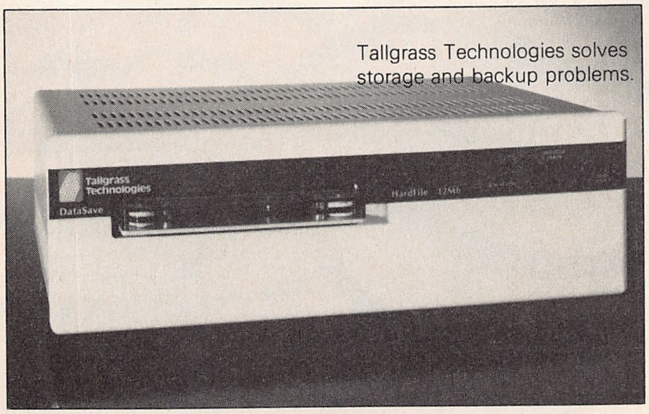

Tallgrass Technologies solves storage and backup problems.

Hard Disk for the IBM PC

Tallgrass Technologies has introduced a 5¼-inch Winchester hard-disk drive with a built-in cartridge tape backup for the IBM Personal Computer.

Available in 6.25- and 12.5-megabyte versions, the system is based on ST-506-compatible Winchester hard disks and the Archive/Cipher quarter-inch streaming tape cartridge drive. A tape cartridge, which meets standards established by the American National Standards Institute (ANSI), stores up to 12.5 megabytes of formatted data.

Tallgrass disk-tape systems start at $4495. Tape cartridges retail for less than $40. Contact Tallgrass Technologies, 9207 Cody, Overland Park, KS 66214.

Circle 212 on inquiry card.

Break Out Those Crayons

Do you hate computer documentation? Have books on programming in machine language made your head spin? Perhaps it's time to switch to something a little less taxing, like a coloring book.

The Computer Coloring Book teaches youngsters about computers in a way they can enjoy. Through the use of 25 full-page line drawings and 50 clear-cut definitions, authors Alan Freedman and Irma Morrison introduce the ABCs of computer technology in a simple, unpretentious manner that makes learning fun.

The Computer Coloring Book is published in softcover by Prentice-Hall and sells for $6.95. For more information, write Prentice-Hall Inc., Englewood Cliffs, NJ 07632.

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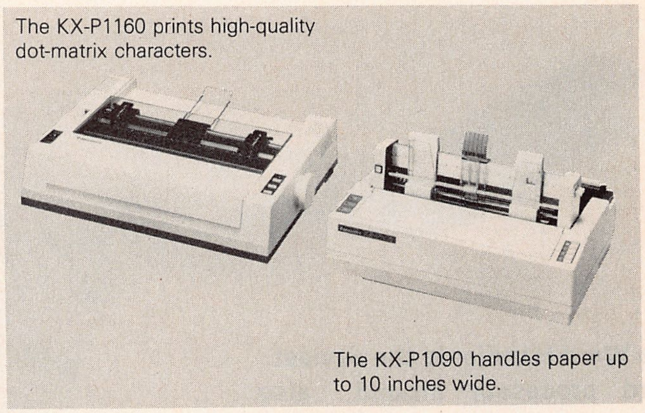

The KX-P1160 prints high-quality dot-matrix characters.

The KX-P1090 handles paper up to 10 inches wide.

Panasonic's Printer Pair

Two dot-matrix impact printers featuring high-speed printing capabilities are now available from Panasonic. Both printers use seamless, continuous-loop ribbon cartridges designed for long life and easy replacement.

The Panasonic KX-P1160 ($1550) is a bidirectional 16-pin printer with logic-seeking head that's designed to print up to 196 characters per second. Its 9 by 13 dot matrix forms 96 ASCII characters with descenders, and the unit has an adjustable-sprocket pin feed capable of handling fanfold paper from 4 to 15 inches wide. An optional front inserter is available for printing single sheets. Equipped with a standard parallel interface, the KX-P1160 also has an optional RS-232C interface and a microprocessor-controlled line-spacing feature that allows selectable forward and reverse spacing.

The Panasonic KX-P1090 ($650) is a bidirectional 9-pin printer that can print at speeds up to 96 characters per second. Characters are printed on a 9 by 9 dot matrix. The printer can accommodate fanfold and single-sheet paper from 4 to 10 inches wide or an 8½-inch roll of paper. It uses an adjustable-sprocket pin feed or friction feed to handle paper. The KX-P1090 has a standard parallel interface and can be used with an optional RS-232C interface.

Both printers feature a bit-image mode for producing graphics. The printers can produce pica (10 characters per inch), elite (12 cpi), and small (20 cpi) type.

Contact Panasonic, One Panasonic Way, Secaucus, NJ 07094.

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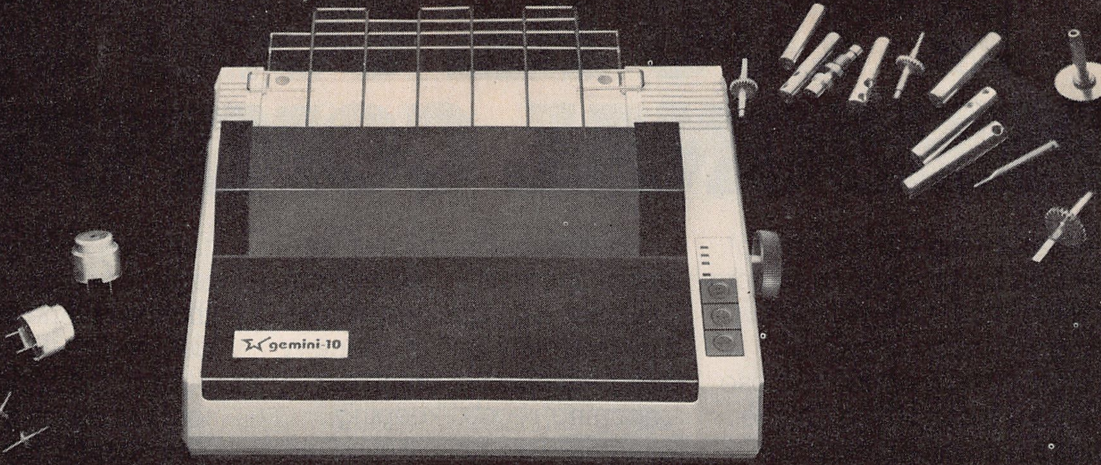

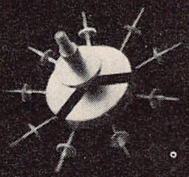

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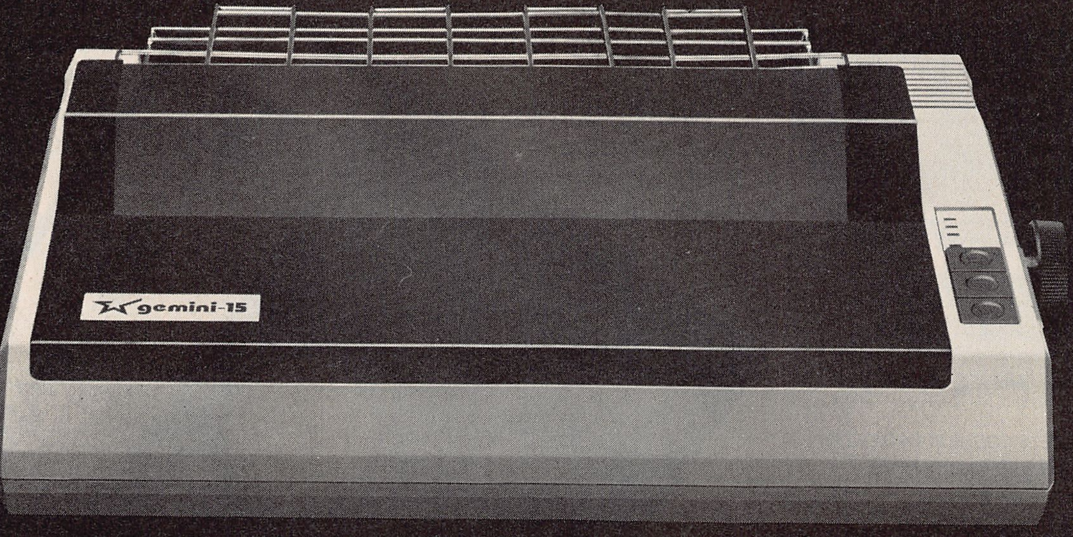
FOR PRINTER VALUE THAT'S OUT OF THIS WORLD



Over thirty years of down-to-earth experience as a precision parts manufacturer has enabled Star to produce the Gemini series of dot matrix printers—a stellar combination of printer quality, flexibility, and reliability. And for a list price of nearly 25% less than the best selling competitor.

The Gemini 10 has a 10″ carriage and the Gemini 15 a 15½″ carriage. Plus, the Gemini 15 has the added capability of a bottom paper feed. In both models, Gemini quality means a print speed of 100 cps, high-resolution bit image and block graphics, and extra fast forms feed.

Gemini's flexibility is embodied in its diverse specialized printing capabilities such as super/sub script, underlining, backspacing, double strike mode and emphasized print mode. Another extraordinary standard feature is a 2.3K buffer. An additional 4 K is optional. That's twice the memory of leading, comparable printers. And Gemini is compatible with most software packages that support the leading printers.

Gemini reliability is more than just a promise. It's as concrete as a 180 day warranty (90 days for ribbon and print head), a mean time between failure rate of 5 million lines, a print head life of over 100 million characters, and a 100% duty cycle that allows the Gemini to print continuously. Plus, prompt, nationwide service is readily available.

So if you're looking for an incredibly high-quality, low-cost printer that's out of this world, look to the manufacturer with its feet on the ground—Star and the Gemini 10, Gemini 15 dot matrix printers.

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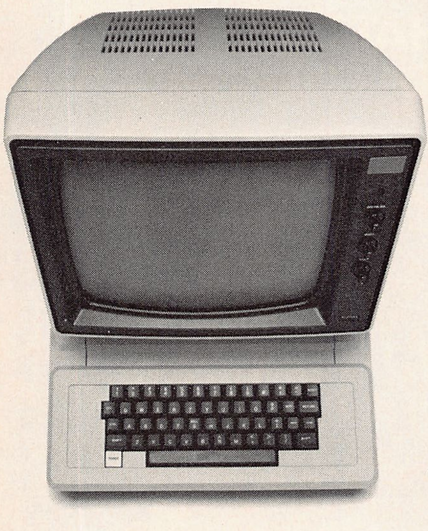
IF YOU'RE CONFUSED PERSONAL COMPUTER,

At this moment, there are no less than 50 personal computers on the market. And more are being introduced every day.

On one hand, having all those options is a good thing. On the other, it can make picking the right one pretty difficult.



Computers come in two parts.
You have to buy both.

We'd like to help. So here are a few suggestions about how to buy the computer that's right for you.

Computers come in two parts.

One part is the "hardware," which is the machinery itself. The other is the "software," or a program, as it's sometimes called.

Software is the part that tells the computer what to do, the way a driver tells a car what to do.

Without software, a computer can't do anything.

And vice versa.

You have to buy both.

Buy the software first.

Since the reason you're buying a computer is to get the capability the software gives you (remember, it's the software that knows how to get things done), it makes good sense to pick the software first.

Start by making a list of the things you want to use the computer for. It can include almost anything—any kind of inventory, filing, accounting, graphics, reporting, record-keeping, analysis—you name it and there's probably a software program that does it.

Next, take the list into a computer store and ask the salesperson to give you a demonstration of the program, or programs, that will do the things you want.

Even though you'll need a computer for the software demonstration, keep in mind the computer is just a vehicle. The software is the driver. And once you've decided on the software, picking out the rest of the computer system will be much easier.

The simpler the better.

Look for software that's easy to learn, easy to use, and that does the job in the simplest way possible.

Good personal software should be, as the computer people say, "friendly." Meaning that it helps you do what you have to do without getting in the way.

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Meaning there are no complicated routines to follow to perform a simple task. And no programming language to learn.

Some people, however, will tell you that software has to be complicated to be powerful.

Nothing could be farther from the truth.

Because in order for a program to appear simple to you on the outside, it has to be extremely complex on the inside.

ABOUT BUYING A HERE'S SOME HELP.

Good software keeps the complications in the computer, where they belong. And keeps the capability at your fingertips. It's that simple.

You simply have to see for yourself.

You can read any number of interesting books and magazines about personal computers. You can ask friends who have them. You can look at all the sales literature you can get your hands on. And you should do all those things before you decide to buy.

But as helpful as all that can be, there really is no substitute for a real, live demonstration.

When you do go out shopping, we recommend you take a look at the PFS® Family of Software.

The PFS family is designed the way we think all software should be: simple, straightforward and powerful.

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Basically, FILE works like a paper filing system, without the paper. So you can record, file, retrieve and review information in a fraction of the time it takes with a conventional filing system.

FILE lets you arrange your information in "forms" you design yourself. So you can get at and really use your information in ways never before possible.

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REPORT summarizes the information on your forms so you can use it to analyze, plan and make better-informed decisions.

With REPORT, you get presentation-quality reports—sorted, calculated, formatted and printed—automatically, in seconds.

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GRAPH gives you presentation quality bar charts, line graphs, and pie charts, in black and white or color, on paper or the computer screen. To get a clearer picture of things and spot trends instantly, you simply enter your information and specify the kind of graph or chart you want. GRAPH does the rest.

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Business

Advanced Software Business System—A set of three business programs: General Ledger, Accounts Receivable, and Accounts Payable. The number of account files is limited only by memory size. Each program can handle up to 99 different revenue centers. For **CP/M-based** systems. The entire package sells for $1200; General Ledger, $650; Accounts Receivable and Accounts Payable, $400 each. Advanced Software, 301 Wilcrest #7406, Houston, TX 77042.

The Apple-IBM Connection—A program that lets you transfer information between **Apple II** and **IBM Personal Computers.** Electronic mail can also be exchanged between these two systems, or from one Apple to another or one IBM to another. For the **Apple II** and **IBM Personal Computer;** $195. Alpha Software Corp., Suite 400, 6 New England Executive Park, Burlington, MA 01803.

Bottom Line Strategist—An econometric forecasting tool that provides the financial answers for proposed business ventures. This program displays 11 types of financial and marketing forecasts and takes into consideration such factors as profits, monetary risks, and break-even points. For **CP/M-based** systems; $400. Ashton-Tate, 10150 West Jefferson Blvd., Culver City, CA 90230.

Business Depreciation Package—A program listing that lets you calculate the depreciation of a piece of equipment so that you can deduct it on your tax return. Taken into consideration are initial cost, estimated life of equipment, salvage value, and estimated worth. For the **Sinclair ZX81** and **Timex/Sinclair 1000;** BASIC program listing, $1 (include a self-addressed, stamped envelope). Florida Creations, POB 16422, Jacksonville, FL 32245.

Dental Office Management III—A package designed for single- or group-practice dental offices. The program offers appointment scheduling, a billing system, and claims form preparation for standard American Dental Association insurance forms. Requires 128K of memory and disk BASIC. For the **Apple III;** floppy disk, $1595; hard disk, $1695. Charles Mann & Associates, Micro Computer Division, 55722 Santa Fe Trail, Yucca Valley, CA 92284.

Easyplanner—A financial-analysis spreadsheet aimed at professionals and middle management businesspersons. The main feature of this package is programmability: you can specify a series of steps in performing financial calculations. For the **IBM Personal Computer;** $250. Information Unlimited Software Inc., 2401 Marinship Way, Sausalito, CA 94965.

Financial Facts—A set of 18 programs designed to calculate and forecast information on various loan, savings, and investment plans. This package covers depreciation, future value, interest rates, payments, deposits, and withdrawal values. For the 48K-byte **Apple II** with Applesoft; $59.95. Howard W. Sams & Co. Inc., 4300 West 62nd St., POB 7092, Indianapolis, IN 46206.

Know Your Client—A database manager that has the ability to store and retrieve personal and professional data on any of your business clients. The program keeps you informed of clients that have not been contacted in the past 30 or 60 days and reminds you to follow up on important tasks. User-defined reports can be set up and prepared without programming. For the **Apple II** and the **IBM Personal Computer;** $124.95. Execuware, Suite 348, 4530 Park Rd., Charlotte, NC 28209.

PDQ—A data-handler program that allows you to create small- to medium-sized files based on your own specific needs. Each screen has a capacity of up to 840 characters that can be edited, saved, moved, and retrieved at any time. For the 48K-byte **Apple II;** $59.95. Howard W. Sams & Co. Inc. (see address above).

Pipe-flo—A program for engineers that helps solve design and installation problems related to laying pipe lines. The program stores information on piping materials, pipe sizes, and valve coefficients. It allows you to enter your own data on each project. For the **Osborne 1** with MBASIC; $275; manual alone, $25. Engineered Software, 2420 Wedgewood Dr., Olympia, WA 98501.

P. M. P. 2000—A property management program for landlords. This program supplies answers to questions by using your known data. Individual modes include apartment status report, tenant status report, cash receipt worksheet, invoices, distribution of expenses/bank account statement, and income/expense schedules. For the **Atari 400 and 800;** $199.95. Talcove & Familian Co., 10902 Riverside Dr., North Hollywood, CA 91602.

Psychiatric Interview and Diagnosis—An interview program designed to help physicians and other specialists to make consistent and accurate psychiatric diagnoses of their patients. For the **Apple II,** requires a **Microsoft BASIC** card. Apple Diagnostic Interview schedule, $300. Apple Automatic-Prompt (questions are obtained directly from the computer as opposed to the test booklet), $500. For more information, contact Apple DIS, Department of Medical Genetics, City of Hope Medical Center, Duarte, CA 91010.

Quick-Search Librarian—A database manager that maintains and tracks files of

New Software provides up-to-date listings of the latest releases in microcomputer software, grouped into seven categories: Business, Games, Home, Education, Programming Languages, Word Processing, and Technical Tools. New Software listings are based on product information supplied by the manufacturers and should not be considered endorsements of the products listed. For in-depth evaluations of the most important and interesting new releases, read our Software Review section.

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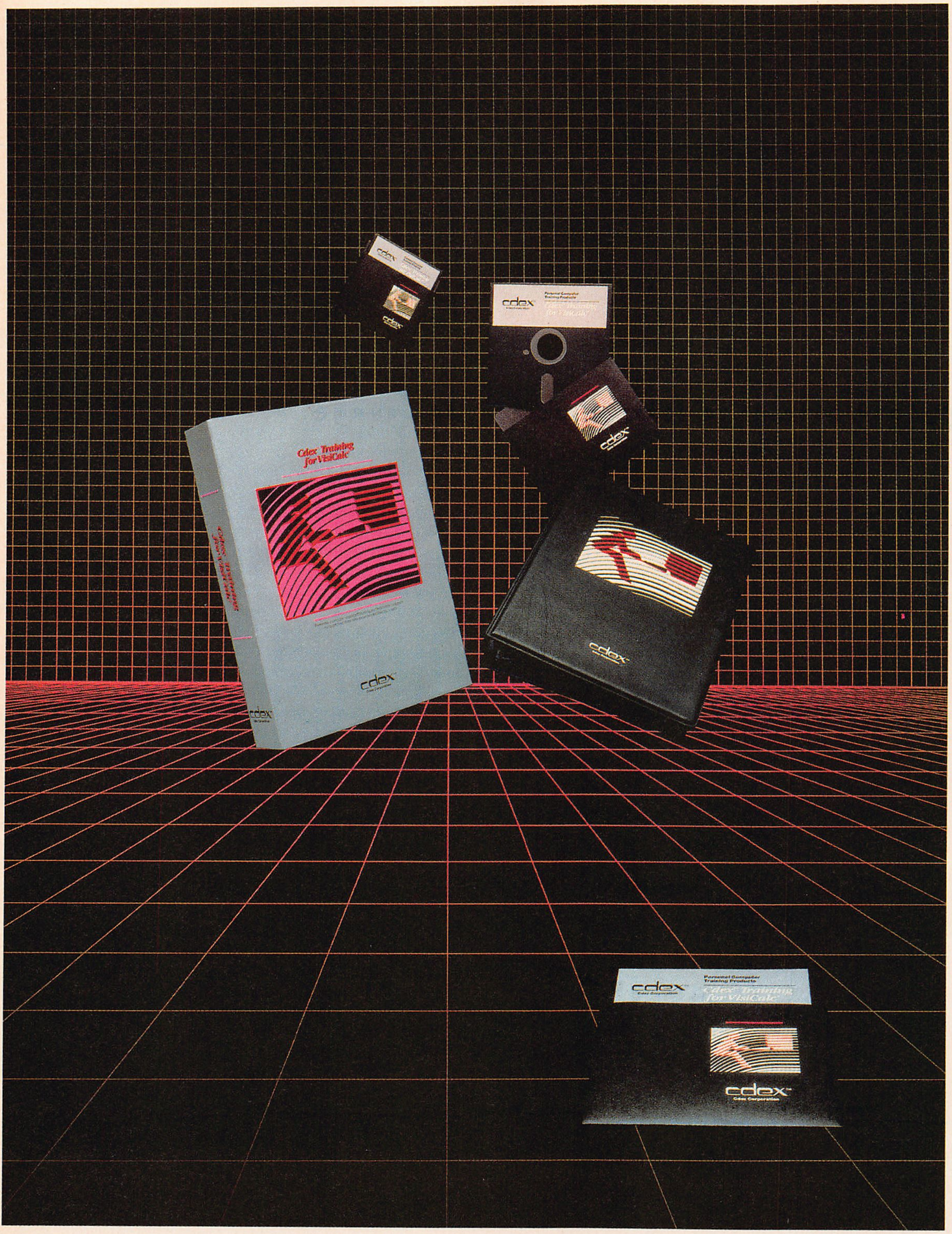
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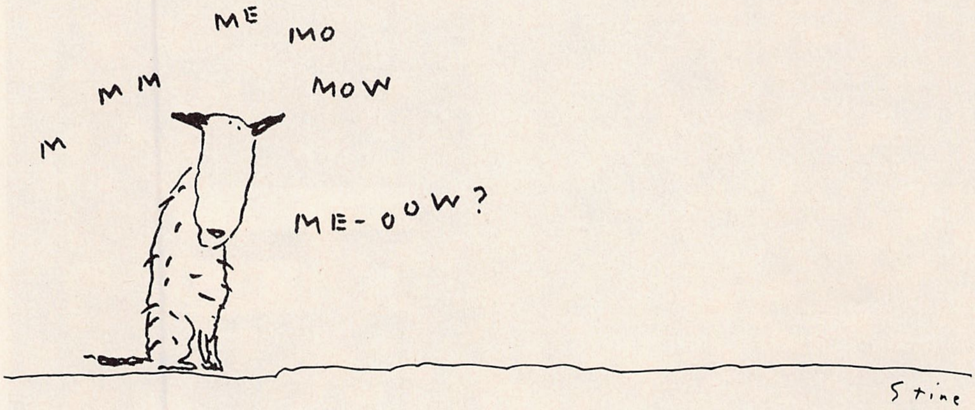

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Sapana Mail Track I—A mailing-list manager that can accommodate both domestic and foreign addresses. It holds up to 1100 entries per single-sided disk. Entries are organized as files in zip code order, but can be retrieved by any part of the name or address. For the **IBM Personal Computer** with PC-DOS; $29. Sapana Micro Software (see address above).

Stock Option Analysis—A program for investors designed to calculate and project profits and losses on stock option transactions. Prices can be obtained directly from Dow Jones by going online or entered manually. For the **Apple II;** $250. H & H Scientific, 13507 Pendleton St., Fort Washington, MD 20744.

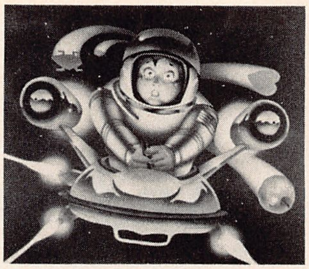
SSI Legal—A time and billing package for law offices or businesses that base client fees on time. The program calculates the charge for services rendered based on user-defined standard fees for such items as consultation, research, or court time. These fees can be changed to suit individual cases. It handles up to 25 professionals. For the **IBM Personal Computer;** $495. Satellite Software International, 288 West Center St., Orem, UT 84057.

Visilink—A program that allows you to obtain information over the telephone from Data Resources Inc., the world's largest private business data bank. The information is sent in the form of **Visicalc** worksheets that can be used with **Visicalc** and other **Visicorp** programs. The program works like an electronic mail-order system. A disk catalog of available subjects is updated quarterly, and charges are based on the information requested. For the **Apple II** equipped with a **Hayes Micromodem II, Novation Apple-Cat II,** or **212 Apple-Cat II** modem; $250. Visicorp, 2895 Zanker Rd., San Jose, CA 95134.

Games

The Caves of Olympus—An adventure game situated on the planet of Olympus, which has just been invaded by soldiers from the nearby star, Loren. For you, the only refuge is the underground caves where an escape vessel is hidden, but many obstacles lie between you and the ship. For the **Apple II;** $39.95. Howard W. Sams & Co. Inc., 4300 West 62nd St., POB 7092, Indianapolis, IN 46206.

Galactic Blitz—An arcade-type game that sends you speeding through space as a barrage of alien objects attack from all directions. To score points and win the game, you try to eliminate as many aliens as possible. For the **Commodore VIC-20;** $24.95. Tronix Publishing Inc., 701 West Manchester Blvd., Inglewood, CA 90301.



Games for the II—A collection of five arcade-type games: Skydiver, Star Battle, The Wall, Space Swarm, and Mayhem. For the **TRS-80 Model II;** 8-inch floppy disk, $29.95. Maryland Model II Games, 3304 Carlton Ave., Temple Hills, MD 20748.

Kid Grid—An arcade-type game. Try to connect the dots by maneuvering the Kid around the grid. To prevent you from doing this, the game provides four bullies who attack you from different sides. The speed at which the Kid moves increases with your skill. For the **Atari 400** and **800;** $29.95. Tronix Publishing Inc. (see address above).

Microcosm—A strategic and analytical game based on a simulation of birth, life, migration, and death among populations of micro-organisms. The object is to create the most fertile microbe colony. Microcosm can be played against the computer or another player. For the **IBM Personal Computer;** $39.95, plus $2 for postage and handling. Aeon Concepts, POB 12595, Pittsburgh, PA 15241.

Micro Mother Goose—A package of three games for children ages 3 to 9. The games start out simply but increase in difficulty at each level. Included in the package are six Mother Goose stickers, a poster, and a disk label for the backup disk. Requires a paddle or joystick. For the **Apple II;** $39.95. Software Productions Inc., 2357 Southway Dr., POB 21341, Columbus, OH 43221.

Set the Hostages Free—To win this game, you must rescue 90 hostages from behind a three-layer-thick stone wall and avoid the attacking guards at the same time. For the **IBM Personal Computer;** $35. Texasoft, 1028 North Madison Ave., Dallas, TX 75208.

Sidewinder—As the Commander of a helicopter squadron, you lead your forces into outer space to battle killer pods and oblitojets. Warning buzzers sound when the enemy approaches. For the **Commodore VIC-20;** $29.95. Tronix Publishing Inc. (see address above).

Space Raiders—A new version of the classic arcade game featuring sound and high-resolution graphics. For the **Radio Shack Color Computer** and the **TDP-100** machine; floppy disk or cassette, $29.95 and $24.95, respectively. Mark Data Products, 24001 Alicia Parkway #226, Mission Viejo, CA 92691.

Squirm—An arcade-type game. An ancient Indian treasure is buried in the jungles of Colombia, South America. You maneuver your snake around the screen in an attempt to gather diamonds while bands of ghosts try to stop you. Each diamond is worth $1000. The initials of the player with the highest score are posted at the bottom of the screen. For the **IBM Personal Computer;** $35. Texasoft (see address above).

Swarm—An arcade-type game that pits you against killer wasps and aliens that attack you from both the air and ground. If you touch one, you are destroyed. Forty levels of difficulty. For the **Commodore VIC-20;** $29.95. Tronix Publishing Inc. (see address above).

Trilogy—Recently reprogrammed for the IBM Personal Computer, these three popular adventure games send you on daring missions in the realm of Middle Earth. Features include action, sound, and music. For the **IBM Personal Computer;** $35. Texasoft (see address above).

Home

Baby Names—A database manager that helps you choose a name for your baby. You input the names of your choice into the computer, and the program then allows you to modify, edit, and manipulate the names to come up with one you like. For the **Apple II** with Applesoft; $29.95. Softhouse, 3806 15th Ave. NW, Rochester, MN 55901.

Check-Matic System—A checkbook record-keeping system designed to track and maintain statements and figures. This program spots and displays erroneous entries and provides options for correcting mistakes. For the **TRS-80 Models I** and **III;** floppy disk or cassette, $20; TRSDOS disk, $35. Bluebird's Computer Software, 2267 23rd St., Wyandotte, MI 48192.

Money Tools—A financial record-keeping system for small businesses or personal use. It lets you keep track of income, expenses, and banking transactions. It also helps you develop a personal budget. Money Tools produces reports on all financial areas. For the **Apple II** with Applesoft; $59.95. Howard W. Sams & Co., 4300 West 62nd St., POB 7092, Indianapolis, IN 46206.

Personal Data Base—A database manager that allows you to create personal or business files and records with user-defined field size and layout. The program can sort two different fields or search three fields simultaneously. For the **IBM Personal Computer** and **CP/M-, CP/M-86-,** or **MS-DOS-based** systems; $125. Supersoft Associates, POB 1628, Champaign, IL 61820.

Tax Return Helper—A set of seven programs designed to assist you with the preparation of tax form 1040 and schedules A, B, C, C1/C2, D, and E. The programs perform numerical calculations and pick up most input errors. Global modifications and corrections are also included. For the **Sinclair ZX81;** $14. Ksoft, 845 Wellner Rd., Naperville, IL 60540.

Education

College Board 1983 SAT Exam Preparation Series—An updated version of the 1982 package that's designed to help increase your Scholastic Aptitute Test (SAT) scores. The series includes 42 programs that cover analogies, vocabulary, reading comprehension, mathematics, and English composition. For **Apple, Atari, Commodore, Franklin, IBM Personal Computer,** and **Radio Shack TRS-80** computers; $299.95. Krell Software Corp., 1320 Stony Brook Rd., Stony Brook, NY 11790.

Geography Scramble—A cube-type game that provides you with a map that you attempt to unscramble in the least number of moves. Included are maps of the world and the U.S. For the **Apple II** with DOS 3.3; $18. Notable Software, POB 1556, Department PC, Philadelphia, PA 19105.

Mastertype—A set of 17 progressive lessons that combine a space-war video game with a typing tutor. The ob-

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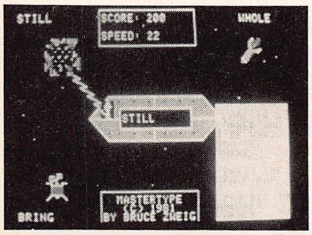
ject of the game/lesson is to correctly type the word that appears in the corner of your screen before an attack missile blows you up. A programming option lets you create your own word games. For the **Atari 400** and **800** and the **Apple II**; $39.95. Lightning Software, POB 11725, Palo Alto, CA 94306.



Mid-Term Report—A system designed to prepare student evaluation reports according to the needs of the school. Teachers can select appropriate comments from up to 99 user-defined items, and the system will automatically produce the notice that will accompany the report card. Two disk drives and an 80-column printer are required. For the **Apple II**; $249.95. Charles Mann & Associates, Micro Computer Division, 55722 Santa Fe Trail, Yucca Valley, CA 92284.

Music Games—Twelve different games designed to teach you how to recognize movement on a staff, notes, rhythm, measures, and musical pitches. For all age groups. For the **Apple II** with Applesoft; $39.95. Howard W. Sams & Co. Inc., 4300 West 62nd St., POB 7092, Indianapolis, IN 46206.

Sofcrates—A menu-driven program that helps teachers create computer lessons. The lesson disk is copyable and features a glossary, multifont color text, questions with remediation, animated graphics, and student progress tracking. No previous programming experience necessary. For the **Apple II**; $199. Simpac Educational Systems, Suite 11-C, 1105 North Main St., Gainesville, FL 32601.

The Teacher PC—This program is designed to teach new users how to operate IBM PC-DOS and its utilities and three levels of the BASIC language. For the **IBM Personal Computer**; $149.95. Charles Mann & Associates (see address above).

Type-It—An enhanced version of the original Type-It program. This version starts by showing you where to place your fingers on the keyboard. You then progress at your own speed, learning one key at a time. The package includes six different exercise options. For the **TRS-80 Models I** and **III**; floppy disk or cassette, $20; TRSDOS disk, $35. Bluebird's Computer Software, 2267 23rd St., Wyandotte, MI 48192.

Word Processing

Metatype—A high-quality word-processing and print-formatting program with proportional spacing and programmable character widths. This menu-driven word processor has the ability to recover deletions, and it safeguards text with a feature that isolates only the section being edited. For **CP/M-based** systems; $360. Westico Inc., 25 Van Zant St., Norwalk, CT 06855.

Palantir Word Processing—A sophisticated second-generation system with standard features such as underlining, boldface, overstrikes, footers, and headers. It includes a mail-merge function. For **CP/M-** and **MS-DOS-based** systems; $450. Designer Software, Suite 718, 3400 Montrose Blvd., Houston, TX 77006.

Word Weaver III—An easily used program with global editing commands for replace, delete, move, kill, and copy functions. Margins can be shaped in various geometric patterns for printing greeting cards, poetry, fliers, etc. For the **Apple III**; $99.95. Synergistic Software, Suite 201, 830 North Riverside Dr., Renton, WA 98055.

Volkswriter 1.0—An updated version of the Volkswriter word-processing package. New features include underlining, boldface characters, improved document chaining, clearer error messages, and increased speed. For the **IBM Personal Computer**; $195. Lifetree Software Inc., Suite 342, 177 Webster St., Monterey, CA 93940.

Technical Tools

Compress—This data-compression system increases the number of files that can be stored on a single disk without losing important information. For **CP/M-based** systems; $59.95. Digital Marketing Corp., 2670 Cherry Lane, Walnut Creek, CA 94596.

Helpware—An integrated series of software-development tools for professional programmers as well as less experienced users. Helpware features an interactive disk-file manager, complete screen editor, and the ability to print while using other options. For the **IBM Personal Computer**; $195. Softwrights Inc., Suite 100, 12606 Greenville Ave., Dallas, TX 75243.

Menu Generator—A complete menu program-development system with the ability to store up to 150 menus. Prompts and operations can be added, edited, deleted, and sorted within each menu, and new menus can be developed using data from existing menus as defaults. For the **Apple II Plus**; $39.95. Crane Software Inc., Suite 611, 16835 Algonquin, Huntington Beach, CA 92649.

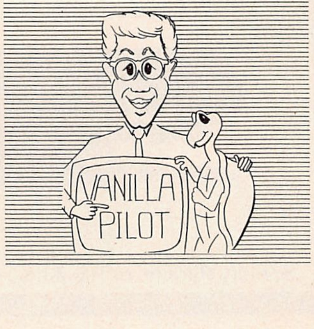
Micro Link—A communications program that allows you to send and receive electronic mail, exchange any text, spreadsheet, data, or program file type, and conduct keyboard conversations. For the **IBM Personal Computer**; $89. Digital Marketing Corp. (see address above).

Strobehires—A plotting program that produces a hard-copy duplicate of any high-resolution graphic image shown on screen. For the **Strobe 100** plotter and the **Apple II** or **III**; $75. Strobe Inc., 897-5A Independence Ave., Mountain View, CA 94043.

Yousable Youtilities—A series of 13 utilities: access, backup, compare, concat, copy, create, delete, dump, find, move, patch, rename, and restore. For **CP/M-** and **CP/M-based** systems; $95. Software Island Inc., Suite 109, 5858 Mt. Alifan Dr., San Diego, CA 92111.

Languages

Vanilla Pilot—An implementation of the PILOT programming language. It includes turtle-graphics commands, a screen editor, and the ability to trace a PILOT program while it is executing. For the **Commodore 64** and **Commodore 4000, 8000,** and **9000** computers; floppy disk or cassette, $29.95. Tamarack Software, Water St., Darby, MT 59829. □



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Electronic Mail

Cut telephone time, stem the paper flow, and increase productivity

by Steve Chernicoff

How much of your time at the office do you spend doing the telephone dance? You know the steps: you need to talk with your friend Bill across the building to ask a quick question, solicit an opinion, or arrange an appointment. You phone, but Bill is away from his desk. If your company's telephone system has a "call forwarding" feature—and if Bill has remembered to use it—a secretary, receptionist, or company message center will answer and you can leave word for Bill to call you back. If no one answers, you can either trot down the hall to leave a note on Bill's chair or wait half an hour and try your call again.

With any luck, Bill has remembered to forward his calls, and you ask his department secretary to have him call you back. A few hours later, though, he still hasn't returned your call. Isn't he back yet? Has he forgotten to pick up his messages? Did yours get lost in the shuffle? If he doesn't call before your three o'clock meeting, you'll be tied up for the rest of the afternoon. It's almost three now—you'd better try him again.

You dial Bill's extension but get his secretary again: Bill was back a while ago and picked up his messages, but he had to run off to an appointment with an important client. He'll get back to you as soon as he gets a chance.

Returning from your meeting, you find a message that Bill telephoned while you were away. You return the call immediately, but he's left for the day. Without conviction, you write "Call Bill" on your list of things to do tomorrow. Maybe you'll reach him, maybe you won't; the dance can continue for days.

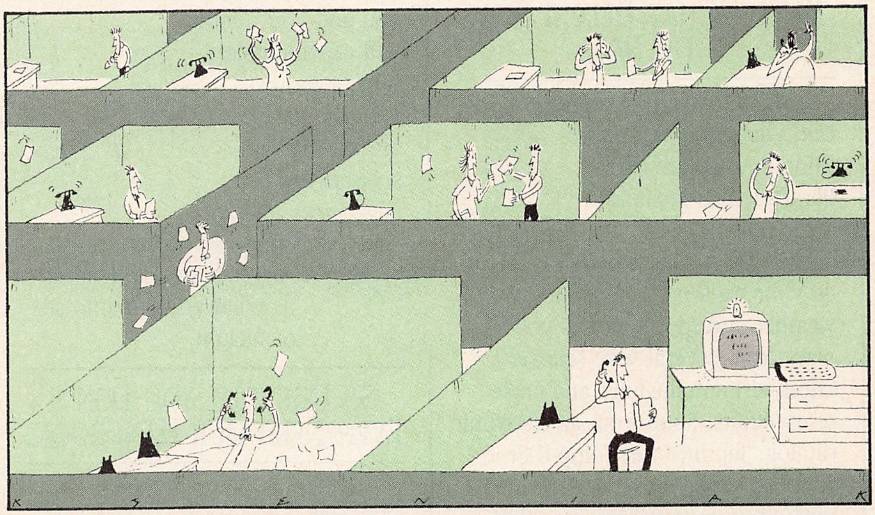

Illustration by Mark Kseniak

The Electronic Alternative

If the telephone dance is an all-too familiar routine in your office, you may be ready for an alternative: electronic mail. Naturally, like any other business decision, adopting an electronic mail system has its pros and cons, its costs and benefits. The costs are generally easy to quantify, but if you've never used a mail system before, the benefits may be less obvious. In addition to increasing your productivity and effectiveness, a mail system can change the nature of your working day, sometimes in unexpected and surprising ways.

To make an informed decision about electronic mail, you need to understand all of its potential advantages. To that end, we'll explore what life with a mail system is like and how it affects a variety of typical day-to-day office activities. To illustrate the point most dramatically, many of the examples are set in a large company where workers are scattered over many departments and several locations. But a good mail system can revolutionize even a relatively

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Steve Chernicoff is director of publications for Apple Computer Inc.

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modest office operation.

Electronic mail may not be for you, but before you rush to that conclusion—especially if people in your office are already using personal computers for word processing, job tracking, forecasting, or other purposes—consider some of the ways a mail system can change your life.

How It Works

Electronic mail is primarily a medium of *internal* communication within a company; it isn't a substitute for postage stamps. Electronic hard-copy delivery services such as the U.S. Postal Service's E-COM (electronic computer-originated mail) and Western Union's Mailgram have their place, but they're most useful for communicating with customers, clients, suppliers, and other outsiders. The real payoff comes when electronic mail is used for routine communication between workers within the same company.

Keeping track of the right 30 recipients for your memo can be a headache in itself.

The essential elements of an electronic mail system are a central mail server to convey messages between senders and recipients, a terminal or workstation for each individual user, and a means of connecting these to the mail server. The system can take any of several forms, depending on your budget and how extensively you're already using computers in your office operations. One approach is to buy mainframe time and file space on a commercial timesharing network such as Compuserve, The Source, or Tymnet and connect to it over ordinary telephone lines by means of low-cost terminals and modems.

If your company owns a mainframe, you can connect terminals to it with high-speed direct communication links instead of using the telephone. In another type of system, employees have full-fledged computer workstations—interconnected over a local network—instead of terminals. In that case the mail server need not be a powerful mainframe; you can use a microcomputer equipped with a large-capacity disk and some specialized software.

Each user's incoming messages are stored in a private, password-protected mailbox file on the mail server while they await delivery. When you connect to the server and "check your mail," you're presented with a list of the messages accumulated in your mailbox. Each message has the sender's name and the date and time it was sent. (Most systems also provide a subject line so that the sender can summarize the message.)

You can now selectively read any message on your screen, transfer it to another file on the server or on your workstation disk, print a hard copy, or simply delete it if you like. Some systems also include facilities for sending a reply message to the original sender or forwarding a copy of a message to a third party along with a cover message of your own.

Getting the Habit

A mail system is most effective when everybody in the office uses it. Unfortunately, workers accustomed to more traditional ways may be slow to incorporate electronic mail into their routines. But once they realize its advantages, most people check their mail several times a day. Once a mail system takes hold, it quickly becomes an indispensable part of office life.

Instead of continuing to talk in generalities, let's look in detail at some examples of electronic mail in action.

Farewell to the Telephone Dance

Electronic mail makes the telephone dance a thing of the past. No longer do you need to get Bill on the other end of a wire in order to communicate. Instead of leaving vague messages all day for him to "please call back," you can state your business right away, in the first message.

The first time Bill returns to his desk, he checks his mail and gets your message. He may not have time to answer just then—mustn't keep that client waiting—but he can act on your message at his earliest opportunity. That's one of the nice things about electronic mail: unlike the telephone, it doesn't demand your instant attention. You receive incoming messages when you choose, and you can deal with them at your convenience. You can also get that big report written without being interrupted by a ringing phone every 10 minutes.

As your afternoon meeting looms, you can check and verify that Bill has picked up his mail instead of wondering helplessly what's become of your message. And by the time you return from your meeting, Bill's answer can be waiting in your mailbox file. Not only do you get what you need—even though you and Bill were never at your desks at the same time—but you each have a "soft" copy of the transaction to keep in your electronic mail files as a permanent record. Your "to do" list for tomorrow is one item shorter, and you can leave for home in a better frame of mind.

The Paper Flood

Offices produce more paper than any other tangible commodity, and at a very high cost. In a typical office, the amount of time, thought, and effort devoted to the physical movement of paper is astonishing. By stemming the tide of paper, electronic mail can help free the company's precious human resources for more productive tasks.

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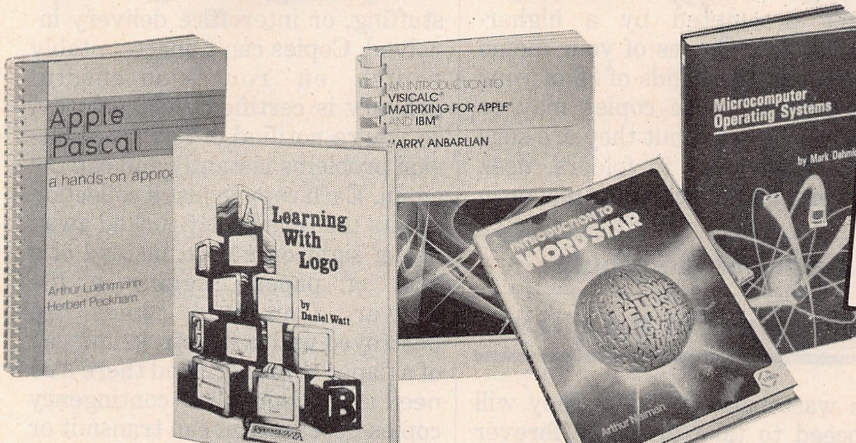

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Perhaps the most revolutionary aspect of electronic mail is its ability to extend the boundaries of the office.

In all, getting your memo distributed might take a couple of days, provided there isn't a large backlog at the copy center and you aren't preempted by a higher-priority job. Copies of your memo are now in the hands of 30 of your co-workers. These copies may or may not be read, but they are sure to be filed away in folders, desk drawers, and file cabinets (never in the wastebasket). There they will proceed to take up space forever and get in the way whenever their owners need to find anything else in the same folder, drawer, or cabinet. And don't forget your five contingency copies, which will take up five times as much space in your office.

Electronic mail changes all that. Your memo goes directly to the recipients' mailbox files. There's no duplicating, collating, envelope stuffing, or interoffice delivery involved. Copies can't unaccountably vanish en route—successful delivery is certified electronically, so you're notified of any transmission problems instantly and can try again. Each copy is just a collection of bits that are neatly tucked away out of sight on a disk, instead of a wad of paper clogging a file drawer. Unwanted copies are destroyed with a keystroke instead of a paper shredder. And there's no need for your five contingency copies because you can transmit or print additional ones as needed from the file copy you keep on your own disk.

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recipients for your memo can be a headache in itself. Departments and project teams change over time; people are reassigned or transfer to other departments, some leave the company, others are hired. Last week's distribution list may be obsolete today. Many mail systems offer a feature that enables you to store your distribution list in a separate file on the mail server. To send a message to such a list, you give the file name instead of typing all the recipients' names individually. Not only does this save time and keystrokes, but it enables you to keep master copies of frequently used lists in a publicly accessible place, where anyone who needs them can use them. As the members of a department or project change, the master distribution list can easily be kept updated, ensuring that all messages get delivered to the right group of people.

The Endless Round Robin

If you think getting Bill on the phone was frustrating, try scheduling a meeting for six. You pick a convenient time on your own calendar—Wednesday morning at ten looks good—and start calling people to see if they're available. Smith and Jones can make it, but Brown is away from her desk when you call. You leave a message for her to call you back, and in the distance you hear the familiar refrain of the telephone dance.

Johnson is tied up all morning Wednesday, but he could get to a meeting in the afternoon. Sorry, you say, your Wednesday afternoon is booked solid—how about Thursday at two? That's agreeable to Johnson, but now you have to check back with Smith and Jones. Smith is free at two on Thursday, but Jones has a conflict—three o'clock would be better for him.

Before you can get back to Smith and Johnson with this new information, Brown returns your earlier call. She's busy all Thursday afternoon but could make it early that morning—how about 8:30? Back

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you go to Smith to start the loop over again. And you haven't even gotten to Williams yet.

The whole exercise is far less painful with an electronic mail system because communications aren't limited to two people at a time. Your initial suggestion of a meeting at ten o'clock on Wednesday morning goes out simultaneously to everyone involved—Smith, Jones, Brown, Johnson, and Williams. All further proposals and counterproposals go on the same list, so there's no need to keep calling people back to keep them posted. When Brown returns to her desk and checks her mail, the accumulated sequence of messages brings her immediately up to date. Instead of being left out in the cold, Williams can take part in the discussion right from the beginning. It may not be any easier to find a mutually convenient time for your meeting, but it's guaranteed to be quicker and less exasperating.

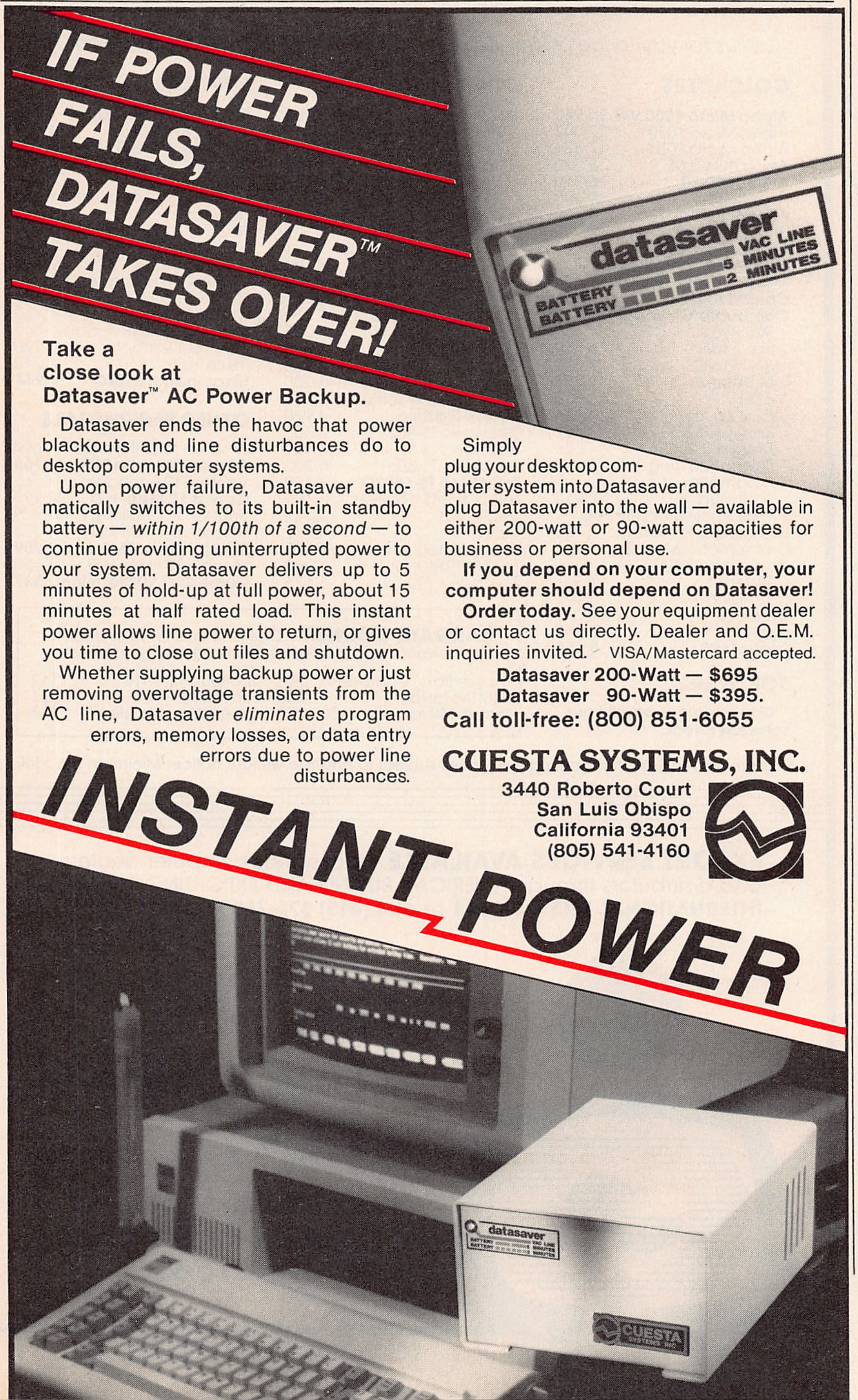
The Virtual Meeting

In fact, with electronic mail at your disposal, you may not need to call that meeting at all. No matter what's on the agenda, chances are you can deal with it directly over the mail system. Instead of using all those messages just to find a suitable time for your meeting, you can devote them to the actual business at hand—discussing an issue, debating a proposal, making a decision—without ever having to assemble all the participants in the same room at the same time. What would have taken two hours apiece for six people can instead be accomplished in 5- and 10-minute time slices "in the cracks" between the day's other activities.

This kind of electronic conference can completely transform the way a company conducts its business. Teams of people hundreds or thousands of miles apart can work together on a project, coordinating their efforts through daily or even hourly contact over the mail system. The weekly coordinating meeting can be replaced by an ongoing group discussion that's more flexible and responsive to day-to-day developments. No one's time needs to be taken up compiling and distributing weekly minutes. Instead, the accumulating message file becomes a documented record of the project's history that's valuable for bringing newcomers "up to speed" as well as for post-mortem analysis. Best of all, people have fewer commitments on their appointment calendars and more time for other work.

The Distributed Office

Perhaps the most revolutionary aspect about electronic mail is its ability to extend the boundaries of the office beyond the confines of a single physical location or a set working day. It doesn't matter if



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INSTANT POWER

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you're out sick, staying home to work on an important report, or across the country on business. As long as you have access to a workstation or terminal and a way to connect to the company mail system, you're as much a part of your office as if you were sitting at your desk. If you're a programmer, a magazine writer, or another notoriously nocturnal type, you can work from 9 p.m. to 5 a.m. and still keep in touch with your more conventional friends on the day shift.

In years to come, the "distributed office" will become more and more commonplace. Already a growing number of companies are offering their employees flexible working hours and regular days at home. Tens of thousands of American workers are already "telecommuting" electronically from home offices. As cheap, portable workstations and terminals become available, this trend can be expected to continue. Telecommuting isn't for everyone, of course, but for those who prefer it, electronic mail is the vital link that helps make it a realistic option.

Mixing Pleasure with Business

Not everything that goes on in an office is related to work. Birthday lunches, football pools, and Friday afternoon cake-of-the-week clubs are as much a part of the scene as meetings, memos, and monthly status reports. The quarterly earnings statement shares space on the bulletin board with intramural softball standings, the week's cafeteria menus, and notices of stereos and motorcycles for sale. Many people spend more of their waking hours at the office than anywhere else; it's as much a social institution as a place of business.

It's only natural, then, that such extracurricular activities should find their way onto the mail system as well. Electronic mail is the perfect medium for organizing a car pool, rounding up a quick fourth for lunchtime bridge, or selling your tickets to Friday night's ballet. In the process, it can also widen your circle of acquaintances within the company by putting you in touch with people in other departments or locations that you might not have met otherwise.

Need a good car mechanic, eye doctor, or real estate agent? Just put out a message asking for recommendations, pro and con. By the end of the day you'll have a pretty good idea of the best and worst, and in all likelihood you'll hear from people who ask you to share your findings.

Affordable Frivolity

Once a mail system is established, people will find an endless variety of uses for it. There may be special-interest distribution lists for swapping recipes, sharing movie or restaurant reviews, or finding tennis partners. In one company, an electronic "fictionary dictionary" game has been going on for years. Each Monday the "czar" for the week chooses an unfamiliar word from the dictionary and sends it out to the other participants. Players have until 5 p.m. Tuesday to submit their bluff definitions, which are published (along with the genuine definition) on Wednesday. Votes are due Thursday, the results are posted on Friday, the czardom passes to the next player on the list, and a new word is sent out for definition.

Of course, such frivolous uses of the mail system don't get any work done, and they're expensive if you're paying for time and space on someone else's computer. But if your mail system is your own, you can afford a little frivolity. By making even the fun and games more efficient, electronic mail can free people for more productive purposes. Such diversions can actually increase the effectiveness of the mail system by encouraging people to use it and to check their mail more often. They also help strengthen the personal bonds between co-workers and build a sense of community and group loyalty. In the long run, that may be the most important benefit of all. □

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by Joseph Segor, Pres.

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Flight Simulator (Sublogic)	33.50	**27.00**
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Sargon II (Hayden)	34.95	**27.95**
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Computer Baseball (Strategic Simulations)	39.95	**33.00**
Zork II (Infocom)	39.95	**31.95**
Zork III (Infocom)	39.95	**31.95**
Star Cross (Infocom)	39.95	**31.95**
Lovers or Strangers (Alpine)	29.95	**24.85**
Deadline (Infocom)	49.95	**39.95**
Wizardry (Sir Tech)	49.95	**39.95**
BUSINESS		
VisiCalc (Visicorp)	250.00	**189.00**
PFS: File (Software Publishing)	125.00	**93.75**
DB Master (Stoneware)	229.00	**171.25**
DB Utility Pack #1 (Stoneware)	99.00	**79.00**
DB Utility Pack #2 (Stoneware)	99.00	**79.00**
VisiTrend/VisiPlot (Visicorp)	300.00	**225.00**
PFS: Graph (Software Publishing)	125.00	**93.75**
Multiplan (Microsoft)	275.00	**220.00**
VisFile (VisiCorp)	250.00	**189.00**
Screenwriter II (On-Line)	129.95	**97.00**
Versaform (Applied Software Technology)	389.00	**299.00**
HOME		
Home Accountant (Continental)	74.95	**62.00**
Dow Jones Market Analyzer (Dow Jones)	350.00	**295.00**
Transcend I (SSM)	89.00	**73.00**
Transcend II (SSM)	149.00	**121.00**
UTILITIES		
Bag of Tricks (Quality)	39.95	**33.00**
Graphics Magician (Penguin)	59.95	**49.75**
DOS Boss (Beagle Bros.)	24.00	**19.00**
EDUCATION		
Master Type (Lightning)	39.95	**31.95**
Algebra I (Edu-Ware)	39.95	**33.00**
Bumble Games (Learning Company)	60.00	**49.00**
Compu-Read (Edu-Ware)	29.95	**24.00**
ATARI 400/800 Disc		
ENTERTAINMENT		
Temple of Apshai (Automated Simulations)	39.95	**33.00**
Arcade Baseball (Arcade Plus)	34.95	**29.00**
Crossword Magic 2.0 (L&S Computerware)	49.97	**37.45**
Zork II (Infocom)	39.95	**29.95**
BUSINESS		
VisiCalc (VisiCorp)	250.00	**189.00**
Atari Word Processor (Atari)	149.95	**120.00**
HOME		
Family Cash Flow (Atari Program Exchange)	22.95	**19.00**
Home Filing Manager (Atari)	49.95	**37.45**
UTILITIES		
Disk Detective (Datasoft)	29.95	**24.85**
Softerm (Datasoft)	49.95	**39.95**
EDUCATION		
Master Type (Lightning)	39.95	**29.95**
Speed Read Plus (Optimized Systems)	59.95	**49.75**
My First Alphabet (Atari)	34.95	**29.00**
Compu-Read (Edu-Ware)	39.95	**33.00**

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Getting Your Micro Repaired

Practical tips uncovered by our ace reporter

by William Barden Jr.

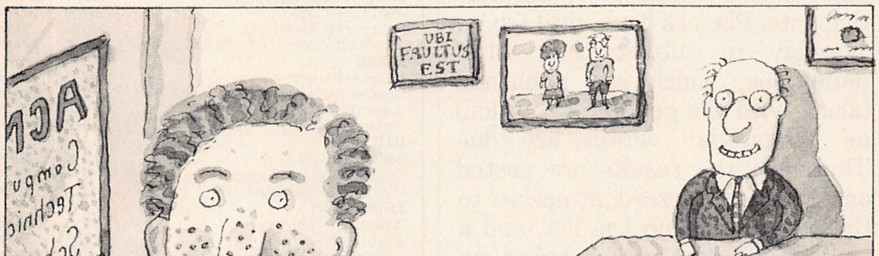
"Barden?"

"Yes, chief?"

I turned toward Perry Black, the editor in chief.

"As Micropolis's largest paper, we've got a sworn duty to perform. We've got to expose fraud and corruption wherever we find it!"

"Right, chief!" I agreed.



"I want you to research the Acme Computer Technician's School over on the north side of town. Find out why some people are being ripped off on their computer service bills," said the pugnacious editor, his cigar protruding from his bulldog jaw. "And take this IBM Personal Computer down to have it fixed at the same time," he added, pointing to his personal executive workstation.

"I thought Kent covered those exposés," I remarked.

"Kent's off with Lois somewhere," he replied. "That wimp is never around when you want him."

The Acme School

An hour later I had called Principal Chip, the head of Acme, and set up an appointment. He gladly consented to see me, eager for publicity for his school and unaware that I was looking for *Enquirer*-type material.

I pulled up in front of the school, a modest but neat two-story building. As I walked into the reception area, IBM Personal Computer in hand, I noticed the inscription over the archway—*Ubi Faultus Est*?

"Barden, reporter for the *Daily Globe*, to see Principal Chip," I announced to the receptionist, who was nursing a leg in a large cast.

"Oh yes, Mr. Barden. Principal Chip is expecting you. Walk this way," she replied, hobbling off, crutch in hand. I refrained from doing the obvious.

Moments later, Principal Chip was showing me the facilities.

Acme's Course of Study

"Our students are given a two-year course of study here," said Principal Chip, pausing in front of a bulletin board labeled *Requirements*. "There is really no certification for computer service technicians, just as there is no certification for those who repair autos, washers, or refrigerators," he continued.

"Unlike these other repair services, though, it takes education in electronics, some math, and a smattering of programming to become a competent computer service technician. Computers are complex devices, more so than washing machines, refrigerators, or even automobiles.

"To repair an Apple, a TRS-80, an Atari, or an IBM computer takes about the same training and experience for each computer system. One is not that much different from another from a troubleshooting standpoint. Naturally, the more expensive the system, the more parts it has, and the harder the repair job," he said.

William Barden Jr. lives in Mission Viejo, California, and writes books about small computers.

Illustration by Paul Meisel

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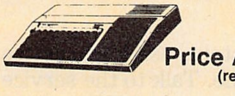

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(rebate offer ends 4-15-83)

TEXAS INSTRUMENTS

Model	Name	Mfr. Sugg. Ret.	Elek-Tek Price
CONSOLE			
PHC 004A	TI-99/4A Home Computer (incl. RF Modulator) (Less $100 Rebate From Texas Instruments)	450.00	**249.00**
PERIPHERALS			
PHP 1200	Peripheral Expansion Box	249.95	**180.00**
PHP 1220	RS-232 Card	174.95	**130.00**
PHP 1240	Disk Controller Card (One Disk Manager module packed with each Disk Controller)	249.95	**180.00**
PHP 1250	Expansion System Disk Drive (Disk Drive Controller required)	399.95	**285.00**
PHP 1260	Memory Expansion Card (32K RAM)	299.95	**215.00**
PHP 1270	P-Code Card (32K RAM Memory Expansion required)	249.95	**180.00**
PHP 1500	Solid State Speech™ Synthesizer	149.95	**110.00**
PHP 1850	Disk Memory Drive (Exterior)	499.95	**350.00**
PHP 2500	TI 80 Column Impact Printer	750.00	**500.00**
PHA 4100	10" Color Monitor	399.95	**320.00**
OPTIONAL ACCESSORIES			
PHP 1100	Wired Remote Controllers (Pair)	34.95	**28.00**
PHA 1950	Thermal Paper (2 Pack)	9.95	**8.00**
PHA 2000	Cassette Cable	14.95	**12.00**
PHA 2010	Monitor Cable	19.95	**15.00**
APPLICATION PROGRAMS			
Home Management/Personal Finance			
	Command Modules		
PHM 3006	Home Financial Decisions	29.95	**24.00**
PHM 3007	Household Budget Management (Data storage system is required)	39.95	**32.00**
PHM 3012	Securities Analysis	54.95	**44.00**
PHM 3013	Personal Record Keeping (Data storage system is recommended)	49.95	**40.00**
PHM 3016	Tax/Investment Record Keeping (Disk system is recommended)	69.95	**56.00**
PHM 3022	Personal Real Estate (Data storage system is recommended)	69.95	**56.00**
PHM 3044	Personal Report Generator (Data storage system is recommended)	49.95	**40.00**
PHM 3111	TI Writer (32K Memory Expansion required)	99.95	**75.00**
PHM 3113	Microsoft™ Multiplan™ * (32K Memory Expansion required)	99.95	**75.00**
	Diskette		
PHD 5001	Mailing List	69.95	**56.00**
PHD 5003	Personal Financial Aids	19.95	**16.00**
PHD 5021	Checkbook Manager	19.95	**16.00**
PHD 5022	Business Aids Library—Finance Management (Extended BASIC Command Module is required)	39.95	**32.00**
PHD 5024	Business Aids Library—Inventory Management (Personal Record Keeping or Statistics Command Module is required)	69.95	**56.00**
PHD 5027	Business Aids Library—Invoice Management (Personal Record Keeping or Statistics Command Module is required)	69.95	**56.00**
PHD 5029	Business Aids Library—Cash Management (Extended BASIC Command Module is required)	39.95	**32.00**
PHD 5038	Business Aids Library—Lease/Purchase Decisions	69.95	**56.00**
	Cassette		
PHT 6003	Personal Financial Aids	14.95	**12.00**
PHT 6038	Business Aids Library—Lease/Purchase Decisions	59.95	**45.00**
Documentation Section for Young Minds			
PHA 2606	Creative Programming Computer Competency Series—Volume 1	9.95	**8.00**
PHA 2607	Creative Programming Computer Competency Series—Volume II	9.95	**8.00**
PHA 2608	Creative Programming Computer Competency Series—Volume III	9.95	**8.00**
PHA 2609	Creative Programming Computer Competency Series—Allstar Projects	9.95	**8.00**
Educational/Personal Enrichment			
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DLM Arcademics			
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PHM 3116	Demolition Division	39.95	**32.00**
PHM 3118	Minus Mission††††	39.95	**32.00**
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PHM 3004	Number Magic	19.95	**16.00**
PHM 3005	Video Graphs	19.95	**16.00**
PHM 3008	Video Chess	69.95	**56.00**
PHM 3010	Physical Fitness	29.95	**24.00**
PHM 3020	Music Maker (Data storage system is recommended)	39.95	**32.00**
PHM 3021	Weight Control and Nutrition (Data storage system is recommended)	59.95	**48.00**
PHM 3040	TI LOGO (Memory Expansion is required)	129.95	**75.00**
PHM 3064	Touch Typing Tutor* (Available for TI-99/4A only)	39.95	**32.00**
PHM 3109	TI Logo II* (32K Memory Expansion is required)	129.95	**75.00**
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PHM 3015	Early Reading (Solid State Speech™ Synthesizer is required)	54.95	**44.00**
PHM 3043	Reading Fun (Solid State Speech™ Synthesizer is recommended)	54.95	**44.00**
PHM 3046	Reading On	54.95	**44.00**
PHM 3047	Reading Roundup	54.95	**44.00**
PHM 3048	Reading Rally	54.95	**44.00**
PHM 3082	Reading Flight	54.95	**44.00**
PHM 3027	Addition and Subtraction I (Solid State Speech™ Synthesizer is recommended)	39.95	**32.00**
PHM 3028	Addition and Subtraction II (Solid State Speech ™ Synthesizer is recommended)	39.95	**32.00**
PHM 3029	Multiplication I (Solid State Speech™ Synthesizer is recommended)	39.95	**32.00**
PHM 3049	Division I (Solid State Speech™ Synthesizer is recommended)	39.95	**32.00**
PHM 3050	Numerations I	39.95	**32.00**
PHM 3051	Numerations II	39.95	**32.00**
Scholastic Packages (Developed by Scholastic, Inc.)			
PHM 3059	Scholastic Spelling—Level 3 (Solid State Speech™ Synthesizer is required)	59.95	**48.00**
PHM 3060	Scholastic Spelling—Level 4 (Solid State Speech™ Synthesizer is required)	59.95	**48.00**
PHM 3061	Scholastic Spelling—Level 5 (Solid State Speech™ Synthesizer is required)	59.95	**48.00**
PHM 3062	Scholastic Spelling—Level 6 (Solid State Speech™ Synthesizer is required)	59.95	**48.00**
Addision-Wesley Computer Math Games (Developed by Addison-Wesley Publishing Co.)			
PHM 3083	Computer Math Games II	39.95	**32.00**
PHM 3088	Computer Math Games VI	39.95	**32.00**
Milliken Home Math Series—K thru 8th grade (Developed by Milliken Publishing Co.)			
PHM 3090	Addition*	39.95	**32.00**
PHM 3091	Subtraction*	39.95	**32.00**
PHM 3092	Multiplication*	39.95	**32.00**
PHM 3093	Division*	39.95	**32.00**
PHM 3094	Integers*	39.95	**32.00**
PHM 3095	Fractions*	39.95	**32.00**
PHM 3096	Decimals*	39.95	**32.00**
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PHM 3099	Laws of Arithmetic	39.95	**32.00**
PHM 3100	Equations	39.95	**32.00**
PHM 3101	Measurement Formulas	39.95	**32.00**
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Texas Instruments Packages			
PHD 5007	Teach Yourself BASIC	34.95	**28.00**
PHD 5009	Music Skills Trainer	29.95	**24.00**
PHD 5011	Computer Music Box	19.95	**16.00**
PHD 5018	Market Simulation	19.95	**16.00**
PHD 5019	Teach Yourself Extended BASIC (Extended BASIC Command Module is required)	24.95	**20.00**
PHD 5020	Music Maker Demonstration (Music Maker Command Module is required)	14.95	**12.00**
PHD 5023	Basketball Statistics (Extended BASIC Command Module is required)	24.95	**20.00**
PHD 5026	Bridge Bidding I	29.95	**24.00**
PHD 5030	Speak & Spell™ Program (Solid State Speech™ Synthesizer is required)	29.95	**24.00**
PHD 5031	Speak & Math™ Program (Solid State Speech™ Synthesizer and Terminal Emulator II are required)	29.95	**24.00**
PHD 5039	Bridge Bidding II	29.95	**24.00**
PHD 5041	Bridge Bidding III	29.95	**24.00**
PHD 5042	Speller Writer (Terminal Emulator II Command Module and Solid State Speech™ Synthesizer are required)	29.95	**24.00**
PHD 5067	Beginner's BASIC/Tutor	29.95	**24.00**
MECC Packages (Developed by Minnesota Educational Computing Consortium)			
PHD 5078	Metric and Counting* (Extended Basic Command Module is required)	29.95	**24.00**
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PHD 5085	Science Facts* (Extended BASIC Command Module is required)	29.95	**24.00**
PHD 5086	Natural Science* (Extended BASIC Command Module is required)	29.95	**24.00**
PHD 5087	Social Science* (Extended BASIC Command Module is required)	29.95	**24.00**
PHD 5088	Teacher's Tool Box* (Extended BASIC Command Module and printer are required)	29.95	**24.00**
	Cassette		
PHT 6007	Teach Yourself BASIC	29.95	**24.00**
PHT 6009	Music Skills Trainer	24.95	**20.00**
PHT 6011	Computer Music Box	14.95	**12.00**
PHT 6018	Market Simulation	14.95	**12.00**
PHT 6019	Teach Yourself Extended BASIC (Extended BASIC Command Module is required)	19.95	**16.00**
PHT 6026	Bridge Bidding I	24.95	**20.00**
PHT 6031	Speak & Math™ Program (Solid State Speech™ Synthesizer and Terminal Emulator II are required)	24.95	**20.00**
PHT 6039	Bridge Bidding II	24.95	**20.00**
PHT 6041	Bridge Bidding III	24.95	**20.00**
PHT 6042	Spell Writer (Terminal Emulator II Command Module and Solid State Speech™ Synthesizer are required)	24.95	**20.00**
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PHM 3053	TI Invaders	39.95	**32.00**
PHM 3054	Car Wars	39.95	**32.00**
PHM 3057	Munch Man	39.95	**32.00**
PHM 3042D	Tunnels of Doom (2 Diskette Games Included)	59.95	**45.00**
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PHM 3041D	Adventure (Pirate Adventure Diskette Game Included)	49.95	**40.00**
PHM 3041T	Adventure (Pirate Adventure Cassette Game Included)	49.95	**40.00**
Gabriel Industries Packages (Developed by Gabriel Industries)			
PHM 3067	Othello† (Developed by Gabriel Industries)	39.95	**32.00**
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Texas Instruments Packages			
PHD 5002	TI-Trek (with optional speech)	14.95	**12.00**
PHD 5010	Mystery Melody	14.95	**12.00**
PHD 5015	Oldies But Goodies—Games I	19.95	**16.00**
PHD 5017	Oldies But Goodies—Games II	24.95	**20.00**
PHD 5025	Saturday Night Bingo (Solid State Speech™ Synthesizer is required)	29.95	**24.00**
PHD 5037	Draw Poker (Extended BASIC Command Modules is required)	24.95	**20.00**
PHD 5057	Tombstone City: 21st Century (32K Memory Expansion and Extended BASIC Command Module are required)	19.95	**16.00**
PHD 5058	TI Invaders (32K Memory Expansion and Either Extended BASIC or Editor/Assembler Command Module are required)	19.95	**16.00**
PHD 5060	Munch Man (32K Memory Expansion and Either Extended BASIC or Editor/Assembler Command Module are required)	19.95	**16.00**
Adventure International Adventure Series (Developed by Scott Adams) (PHM 3041D required)			
PHM 5046	Adventureland	29.95	**24.00**
PHD 5047	Mission Impossible	29.95	**24.00**
PHD 5048	VooDoo Castle	29.95	**24.00**
PHD 5049	The Count	29.95	**24.00**
PHD 5050	Strange Odyssey	29.95	**24.00**
PHD 5051	Mystery Fun House	29.95	**24.00**
PHD 5052	Pyramid of Doom	29.95	**24.00**
PHD 5053	Ghost Town	29.95	**24.00**
PHD 5054	Savage Island I & II	39.95	**32.00**
PHD 5056	Golden Voyage	29.95	**24.00**
	Cassette		
Texas Instruments Packages			
PHT 6010	Mystery Melody	9.95	**9.00**
PHT 6015	Oldies But Goodies—Games I	14.95	**12.00**
PHT 6017	Oldies But Goodies—Games II	19.95	**16.00**
PHT 6025	Saturday Night Bingo (Solid State Speech™ Synthesizer is required)	24.95	**20.00**
PHT 6037	Draw Poker	19.95	**16.00**
Adventure International Adventure Series (Developed by Scott Adams) (PHM 3041T required)			
PHT 6046	Adventureland	29.95	**24.00**
PHT 6047	Mission Impossible	29.95	**24.00**
PHT 6048	Voodoo Castle	29.95	**24.00**
PHT 6049	The Count	29.95	**24.00**
PHT 6050	Strange Odyssey	29.95	**24.00**
PHT 6051	Mystery Fun House	29.95	**24.00**
PHT 6052	Pyramid of Doom	29.95	**24.00**
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PHT 6056	Golden Voyage	29.95	**24.00**
OTHER APPLICATION PROGRAMS			
	Command Modules		
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Deep Byte's Repair Tips

Barden gleaned these suggestions from a two-hour conversation with his informant, Deep Byte.

- Avoid the "foreign-equipment" syndrome. If you use your system for business, it may be worth your while to buy computer peripherals from one manufacturer, rather than buying less expensive peripherals from various sources. That way you can have all the parts of your system serviced at the same place. Many dealers will not service foreign peripherals.

In addition, foreign peripherals such as character printers, hard-disk drives, and others may have high repair costs. There are several reasons for this. Some of this equipment has only recently been used for microcomputers and carries high service rates better suited to commercial users. Second, service rates may be high because not many units have been sold. You may have trouble locating a repair facility for your exotic peripheral and may even have to ship it back to the factory, a process which may take weeks or even months.

Along the same lines, if you have added your own RAM (random-access memory) chips or foreign boards, you may find trouble in getting service. Some manufacturers simply refuse to work on equipment with foreign attachments.

- Join a users group and possibly get free service. Most users groups have engineers, technicians, or others capable of solving system problems. However, you generally get what you pay for, and if the service is free you can't expect much in the way of a warranty on the workmanship. In addition, part-time repair technicians may have trouble getting certain specialized parts for various computers.
- Try to find out which service centers are the best. Get referrals from users who know. One computer shop in my area states that the average repair is $300, while most others quote $100. This is a large and suspicious discrepancy.
- Get an estimate on how long the repair is going to take. Some places will literally repair the equipment on the spot, the normal repair will take one or two days, and the worst case may take weeks while a special part is ordered. Why wait when someone else may have the part in stock?
- Check about the availability of loaners. Although generally this is not possible, if you protest loudly enough, you may be able to get a loaner while your system is in for repair.
- Seek out authorized repair centers or authorized third-party service first. As an alternative, use local service technicians if they have a good reputation among members of your users group. One advantage of using authorized repair centers is that these shops receive manufacturers' fixes for both hardware and software. These are documentation releases that define bugs in hardware and software and the subsequent changes that must be made. Some of them are very important.
- Cultivate a friendship with the people at your local computer center. If you consistently buy line-printer ribbons, disks, and other equipment from them, chances are they'll give you preferred treatment on repairs.
- When you get the repaired system, ask the service center to list in detail what was done. Talk to the service manager or service technician if possible. Beware of board swaps that fix your problem by substituting a *used* board that may have its own problems. Be paranoid—jot down serial numbers of your boards before sending the equipment in to be serviced.
- Before you take your system in, determine whether the problem is "catastrophic" or one that occurs only under specialized conditions. Catastrophic problems would be such things as gibberish on the screen on power-up, inability to load, or black smoke pouring out of the computer vents. These are the easiest problems to diagnose. Problems that occur under specialized conditions may be harder to find. Make certain that your problem is not in software or operator error. Reduce the problem to simplest terms to help the computer service department.
- An intermittent problem is hard to track down, and the service department may have trouble duplicating it in the shop. Consider living with the annoyance until it becomes a so-called "hard failure."
- If your equipment is large or hard to transport, consider on-site service. This service is not always available or may be available only for systems that cost more than $3000. However, be prepared to pay at least 18 percent of the cost of the equipment for a yearly on-site service contract.
- Should you pay for a hardware or software fix that should have been in the equipment originally? Such problems do exist and should be treated in the same fashion as recalls for automotive defects. Check with your local users group—its members will have information about hardware and software problems. In some cases the fixes will be installed without charge, but usually there'll be an attempt to cover up their existence. You may even be billed for what should have been in the system initially.
- If a board or other component such as a disk drive is replaced, the new component should be warranteed to the same extent that the original system was warranteed. Have the repair shop clearly document which component was replaced. If that component fails within the warranty period (usually 90 days), you shouldn't have to pay for repair, just as you wouldn't pay if an alternator in your car was replaced and failed the next week.
- Have the service shop call you if the repairs will exceed a certain amount. If you then feel that the estimated repair charge will be too high, take the system somewhere else. You will probably have to pay an hour's charge, however, for this preliminary work.
- When you pick up the system, try to test it on the spot. In some cases this means you'll have to bring in additional equipment or programs in which the error occurred. It's well worth the trouble because it's possible that a subtle problem might not be fixed. If your original problem occurred at random times, ask the service people if they "burned in" the system to see if the problem reappeared after the fix. In some cases the technician is operating like others in the repair business since time immemorial—guessing, taking the best shot to try to fix the unit. If the problem does reappear, should you be responsible for experimentation on your machine? That's a tough question. . .

Tools of the Trade

We traveled down a corridor and came to a large laboratory with four long test benches.

"A typical service shop might have one repair technician with six feet or so of test bench. He or she would have an oscilloscope, a device that displays electronic waveforms at different parts of the computer's circuitry; a multimeter to measure voltage and current; a soldering iron; semiconductor and electronic replacement parts; specialized replacement parts for the computer system involved; and service documentation."

"What does a typical service facility cost?" I asked.

"The most important piece of hardware is the oscilloscope," he replied. "Good ones run about $1500 to $2000, although you can get one for less."

"You mean anyone with an oscilloscope and two years' education could repair computers?" I asked.

"Not really. Another component is good documentation on the specific microcomputer. You'd need a set of manufacturer's manuals on the microcomputer and a comprehensive set of diagnostic programs to help you determine which component is failing. You'd also need a stock of spare circuit boards and modules for the computer systems you'd be repairing. To start a service operation would require several thousand dollars.

"Of course," he went on, "the most important component of any service shop is the experience and innate ability of the individual performing the repairs. There are good and bad service technicians just as in anything else. We try to give our men and women the necessary background to repair microcomputers efficiently."

The Average Repair Cost

Probing into the topic of my assignment, I asked "What would you say the average repair would cost for a microcomputer?"

"It really depends upon the computer layout and how modular the computer is. If the computer has a number of plug-in boards, such as the Apple, the computer service technician might be able to localize the fault quickly by swapping modules. Knowing the board or module that was failing, a technician could replace the module and send the defective module back to the factory for repair. Only rarely would a repair technician try to isolate the problem further, down to the chip or integrated circuit level.

"Smithers, could you come here a second?" he called over to an instructor carefully watching two students soldering parts into a board.

"Smithers, could you tell Mr. Barden here about your last three jobs at microcomputer dealers? Smithers worked as a service tech for two years before becoming an instructor," Principal Chip explained.

"Certainly," said the white-smocked instructor, taking off his horn-rimmed glasses, putting his clipboard under his arm, and peering intently at us.

"At the first two places we did a lot of Apple repair work, fixing the typical problems in about one to two hours—usually minor stuff that we found out by module swapping. Of course, we had problem cases too. I remember one that took eight hours to fix, at $50 per hour. I consider myself a good technician, but it was a very subtle problem."

"What about the third company?" I probed.

"That's why I quit service. Repair bills from that store were two or three times higher than other stores," Smithers recalled. "The naive customer was ripped off. And let's face it, what customer isn't naive about how computers work on the chip level."

"Thanks, Smithers," said Prin-

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cipal Chip. Smithers returned to his student group. Judging from a faint acrid smell, the students had apparently burned up one of the components.

Principal Chip continued, "I'd say that many times the average repair job would be one to two hours at $50 per hour plus parts—maybe $100. Some microcomputers can be repaired for a flat rate, however. An Atari 800 can usually be fixed for $89.95. You'll find this flat rate for some of the smaller machines without a lot of options. As I mentioned before, the more complex the machine, generally the longer the service time."

How the User Can Help

"By the way, isn't carrying that IBM Personal Computer a little unwieldy?" Principal Chip asked.

"Yes, a little," I admitted. "I was wondering whether one of your boys could have a look at it."

"Certainly, we'd be happy to." He deposited the PC with one of the students, and then turned to me. "Let me ask you some questions about the problem before we start. Is the problem constant, or does it appear at random times?"

"Uh. . .," I replied.

"Have you checked that it isn't a software problem or even an operating error by running several programs or scanning the manual carefully?"

"Umm. . ."

"Have you run a known good program, and does the problem still appear?"

"Duh. . ."

"Have you written down a complete and accurate list of the problem's symptoms? It'll save you money by helping us define the problem sooner."

"Ah. . .gee, I'm sorry, but this is my boss's computer," I replied.

"That's OK; we'll give it a good going over, anyway. No charge. After all, you're doing the story on us."

"Oh, thanks," I replied, somewhat guiltily, thinking about the exposé.

Service Contracts

"By the way, what can you tell me about service contracts?" I asked.

"Since Acme is not a dealer, I think I can be honest," replied Principal Chip. "Generally, service contracts are just another form of insurance, and the manufacturer wouldn't offer them unless he made a profit. Your typical contract for carry-in service runs about 12 percent of the cost of the equipment, per year. On a $3500 computer, for example, it might run $420. That covers parts and labor," Principal Chip said.

"The question you have to ask yourself is how many service calls you'll need. My feeling is that microcomputer hardware is 'burned in' a great deal more now than it was three years ago, and you shouldn't experience more than one or two failures per year. Electromechanical devices such as line printers and disk drives fail more often than purely electrical devices.

"On the other hand, service contracts do give a business a fixed annual fee that will take care of any problem it has on its system, and that's important for planning."

"Well, I want to thank you very much for the guided tour," I said as we reached the door.

"My pleasure, Mr. Barden. Here's your boss's computer now. Caruthers checked it out and found it in good working order. No problems with it at all."

Deep Byte Calls

As I drove back to the office, I mulled over my visit and what I had learned from my guided tour. Not much in the way of an exposé. Computer service technicians are experienced and competent for the most part. Labor charges average $50 per hour, and most problems can be fixed in an hour or two. But the really thorny problems may wind up being quite expensive to fix. So what else is new. . . Humm, I've got to find some muckraking material here somewhere.

Seated at my desk in front of my video screen, I was stymied. I didn't know where to begin. The phone rang.

"You the guy doing the number on computer service?" a muffled voice asked.

"Yeah, who's this?"

"Just call me Deep Byte."

"Yes, but. . ."

"I've got some information that you might be interested in. Let me fill you in on some controversial material and tips. . ."

He pulled few punches, and when he had finished, I had plenty of useful material. (The bulk of what Deep Byte told me is summarized in the text box on page 56. Some of it was simply too hot for a respectable journal like the *Daily Globe.*)

"Well, that's it, bud. The rest is up to you," said Deep Byte after his discourse on computer repairs.

"Gee, thanks, but who. . ."

"Let's just say I'm someone who got burned on an Altair 8800, an Apple III, and a Radio Shack Model I," he replied and I heard the click of a disconnect.

I finished the article and sent it over to the features editor.

"Barden, this #$%%$ IBM doesn't work!" shouted Perry Black from his office. "What did you do to it?"

"I dunno. They checked it out fine at the Acme School," I replied.

"Chief, I couldn't help overhearing about the problem," said a bespectacled mild-mannered reporter as he walked into the room.

"Kent, you were 60 feet down the hall, how could you hear?"

"Well, uh. . .chief, I think your problem is in the keyboard, the only unit Barden didn't bring into Acme. I think if you'll jiggle the A key a little bit to the right, it'll make better contact, and you'll be off and running."

Perry Black jiggled the A key.

"Great Scott, Kent, I think you've found the problem! How did you do it? That's super!"

I returned to my video display terminal and started on the next story. □

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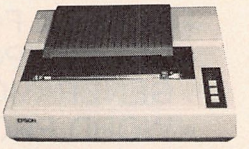

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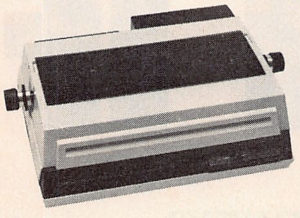

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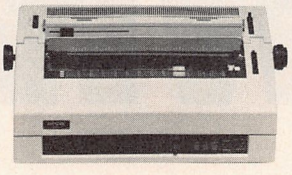

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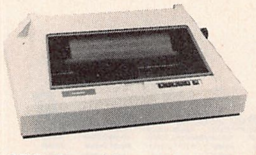

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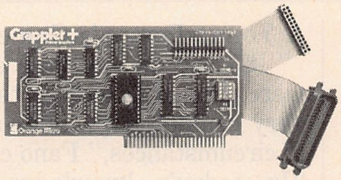

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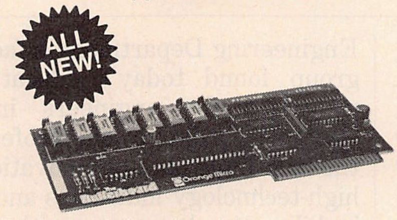

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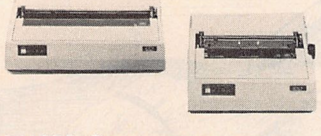

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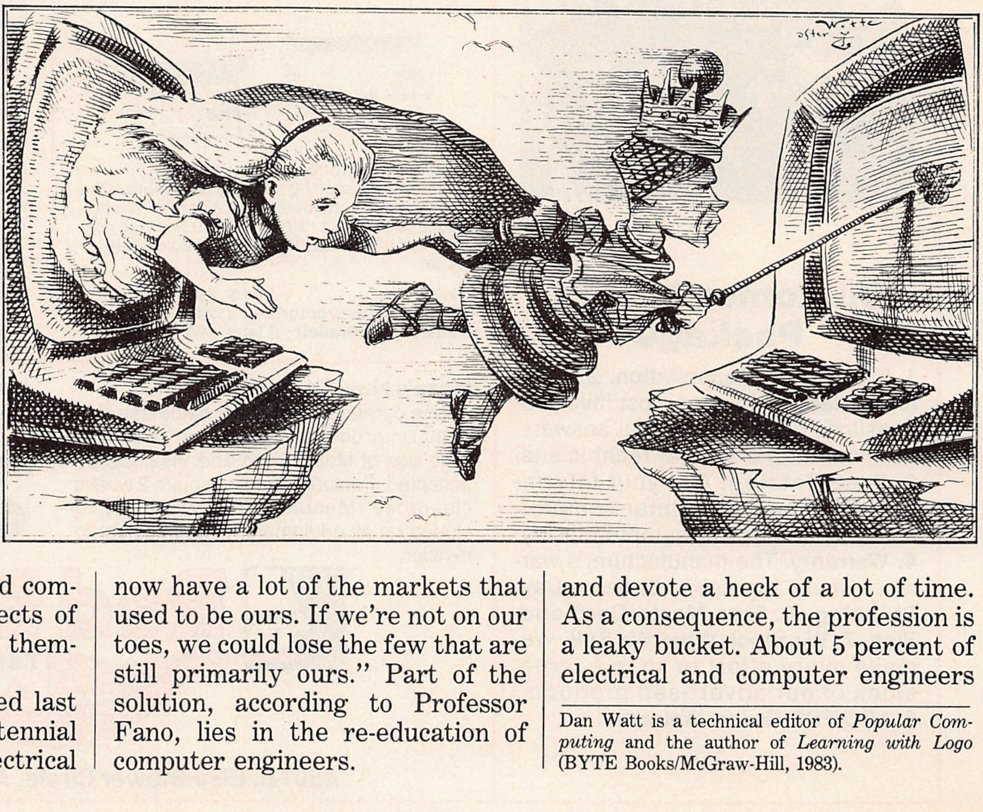
by Dan Watt

> *"Well in our country," said Alice, still panting a little, "you'd generally get to somewhere else—if you run very fast for a long time, as we've been doing."*
>
> *"A slow sort of country!" said the Queen. "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"*—from *Through the Looking Glass and What Alice Found There* by Lewis Carroll

I've been getting that breathless feeling a lot lately. With the onset of the Information Age, most of us are all too painfully aware of the gap between our current knowledge and what we need to know to make effective use of the latest technological advances. Even more distressing, engineers and scientists—people whose professions place them on the leading edge of technology—are feeling out of breath. And according to a recent study released by the Massachusetts Institute of Technology, electronic and computer engineers—the architects of the Information Age—are themselves unable to keep up.



In the study, commissioned last October as part of the Centennial celebration for MIT's Electrical Engineering Department, a faculty group found today's educational programs for engineers inadequate. According to one professor, the incredible pace of innovation in high-technology industries and our inability to keep up with that change is jeopardizing the economic survival of our society. "Let me put it very bluntly," says Robert M. Fano, Ford Professor of Engineering at MIT and chairman of the Centennial Study Committee. "The Japanese and the Europeans now have a lot of the markets that used to be ours. If we're not on our toes, we could lose the few that are still primarily ours." Part of the solution, according to Professor Fano, lies in the re-education of computer engineers.

A Young Person's Game

"It used to be that engineers were expected to do certain things very competently under a variety of circumstances," Fano continues. "In today's knowledge-intensive high-tech industries, they are expected primarily to innovate, and that's a very different business. More and more, people talk about engineering being a young person's game. Once you reach 35, you're not in the front line any more unless you are very, very smart and devote a heck of a lot of time. As a consequence, the profession is a leaky bucket. About 5 percent of electrical and computer engineers

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Dan Watt is a technical editor of *Popular Computing* and the author of *Learning with Logo* (BYTE Books/McGraw-Hill, 1983).

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leave the profession every year," says Fano. "Either they find that it's no longer fun, they're not at the forefront, or they don't see a career ahead of them."

Boston University's Jack Lynch, an engineering professor who has studied the career paths of practicing engineers, confirms Fano's figures on engineering's "leaky bucket." In one 1978 survey cited by Lynch, only 10 percent of approximately 1500 MIT engineering graduates of the 1950s were still in engineering 20 years later. Lynch also confirms the youthfulness of the engineers doing the most advanced work. "If you walk through Texas Instruments," he asserts, "or any other company doing VLSI work (very-large-scale integrated circuits—the backbone of microprocessor technology), the first thing you'll discover is that everyone is under 35. It's not selective hiring. If you place an ad for people who know about VLSI, those are the people you'll get."

The demand for highly creative, up-to-date engineers cannot be met simply by replacing older engineers with new graduates.

Terry Gildea, training manager at Hewlett-Packard, says that the average age of HP's computer engineers is slightly under 30. But he asserts that some job changes are natural and even healthy and may partially explain the predominance of young engineers. "As we go through life our interests change," he says. "We encourage employees to follow their personal interests. If they're interested in a certain area and we have an assignment in a similar part of the organization, we'd be dumb not to put those two things together."

The MIT committee, however, thinks the companies should put more effort into encouraging engineers to stay in engineering. "The demand for highly creative, up-to-date engineers . . . cannot be met by replacing 'obsolescent' (older) engineers with new graduates. . . . The only alternative is better utilization of the presently available engineering work force through continuing education at the work place."

Lifelong Education

The Centennial Study Committee proposes that companies establish an ongoing process they call lifelong cooperative education. According to Professor Fano, "It is no longer realistic to think that a few years of college or graduate school can be an adequate foundation for a lifetime of engineering work. There is too much to learn, and what you've got to know changes too rapidly. Given the pace of innovation, a program of ongoing education is required to avoid obsolescence."

What's exciting about the MIT report is its suggestion of a new attitude toward the relation between work and learning. The committee would like to see "a lifelong commitment to formal education on the part of engineers" paralleled by wholehearted support from their employers. "Eventually, something like 10 percent of an engineer's work time ought to be devoted to educational activities," says Fano. "An engineer ought to be *expected* to study—not just *allowed* to—and to teach as well."

As a model, the committee offers the master's degree program at Stanford University, which involves tutored video instruction at the work place. In Stanford's program, regular university classes are videotaped. The tapes, along with homework assignments and reading materials, are then shipped to the work place where small groups of students and a tutor watch and discuss them. The tutor, an engineer in the company, serves more as a discussion leader than as an expert, and faculty from the home campus grade the assignments. Through the program students can eventually qualify for a master's degree at Stanford without writing a thesis.

The committee's proposal would expand on Stanford's program in several ways. Along with the standard graduate-level courses required for the master's degree, new courses would be offered to deal with what Fano describes as "galloping innovation." "One of the things we intend to do," says Fano, "is to present appropriate versions of undergraduate courses. Engineers who graduated a few years before never heard of a lot of new material in the undergraduate curriculum. The consequences of having a senior engineer, a supervisor, not understand what the kids just out of school are talking about are far reaching."

In addition, Fano would like to develop classes that disseminate information on advanced technology not yet included in the curriculum. "Knowledge doesn't do any good to anybody unless it's transmitted," he says. "The high-technology industries are in the education business, whether they know it or not. We recommend that teams of industry and university people get together and develop new courses that deal with emergent technology. Of course, we have discussed the problem of secrecy, but the knowledge that underlies a new technology is usually not confidential. And even then, what is confidential this year probably won't be next year."

The committee's approach would also expand Stanford's current program by enhancing person-to-person interaction. A few years ago, MIT president Paul Gray criticized Stanford's program for using videotapes in place of on-campus contact among students and professors. Fano feels that new programs can now overcome this limitation.

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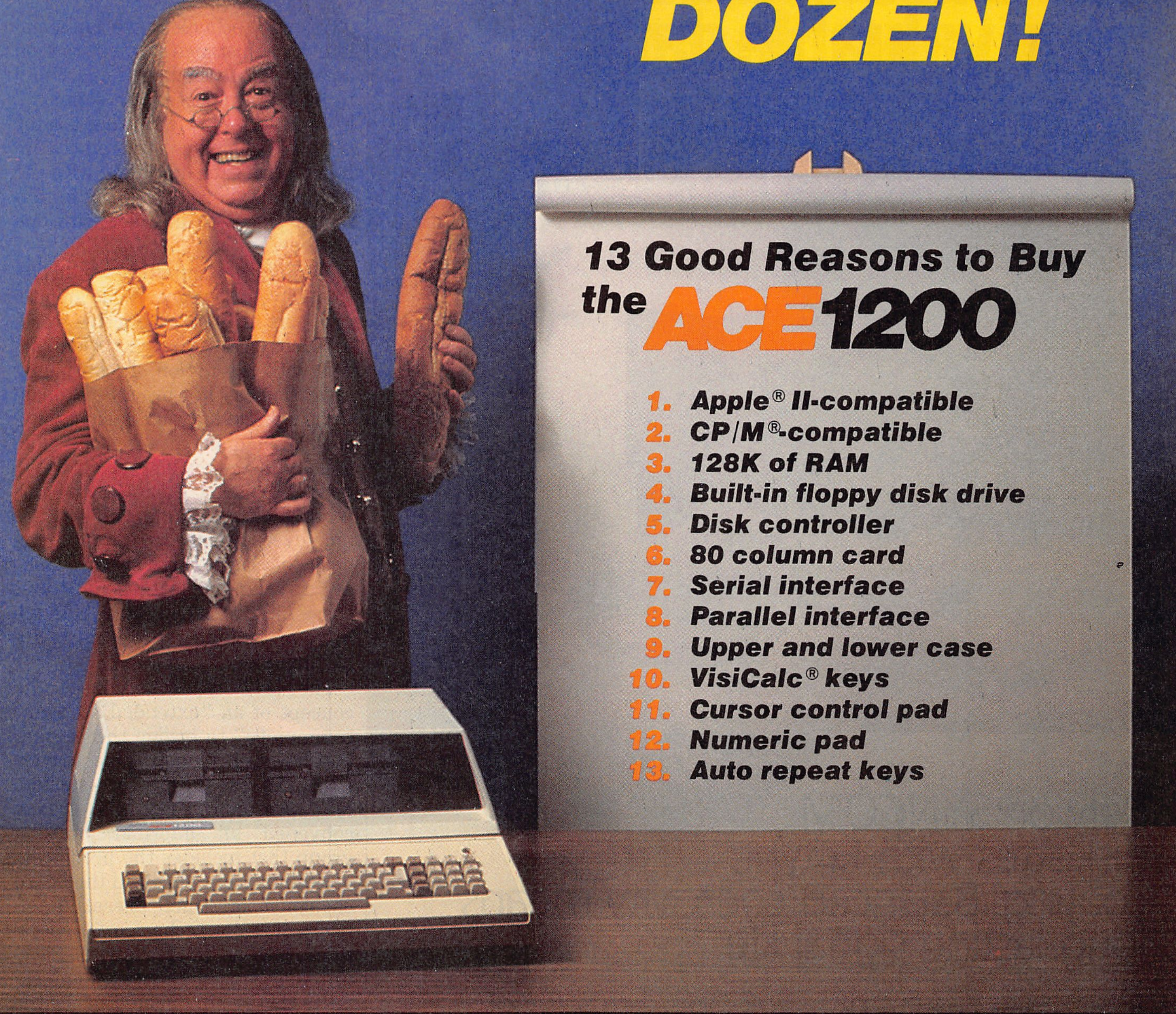

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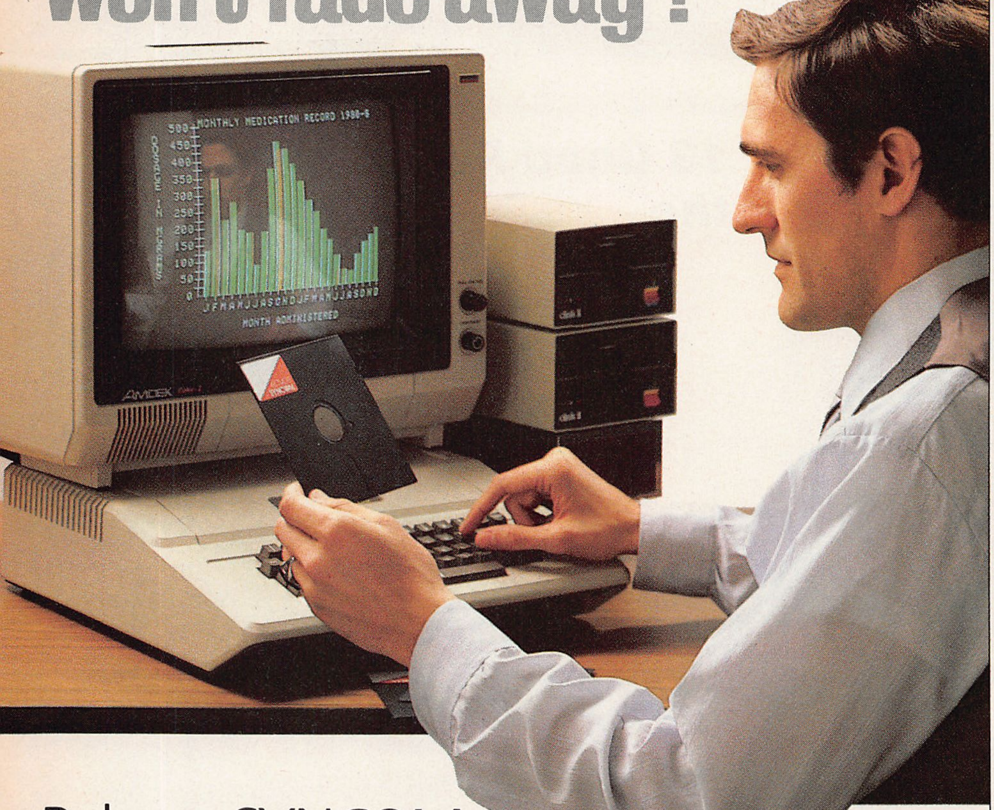

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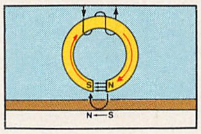

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"Through technology we can simulate at a distance the interaction among people that we have found to be very important on campus," he asserts. "We want to use a tutor network, allowing students to interact with each other and with the staff and allowing tutors in different places to interact with one another."

Finally, the committee would like to involve *all* engineers, as an integral part of their productive work, in such an enterprise. "Contrast this with the notion of 'continuing education' as it's practiced today. Continuing education is something that an engineer does on the side, usually in the evening or on weekends," explains Fano. "Some forward-looking companies give employees release time to go to an optional class. The company looks at this as an employee benefit. But these programs are Band-Aids relative to the kind of problem we are talking about."

The MIT report espouses the concept of an "extended academic community" to bridge the present gap between industry and universities. To get the process started, MIT president Gray has already convened an informal working group that includes the presidents of Stanford and MIT and the board chairmen or chief executive officers of major technology corporations such as IBM, Hewlett-Packard, and Analog Devices. Fano expects this group to help finance the project and to supply key personnel for planning, implementation, and course development. "The most urgent thing for industry to provide to get this going is manpower," he says.

Although optimistic about the ultimate impact of such a program, Fano takes a long view of the process. "It's not going to happen tomorrow," he asserts. "We've just started an experiment. It will probably be a decade before something like this has taken root."

The Reaction

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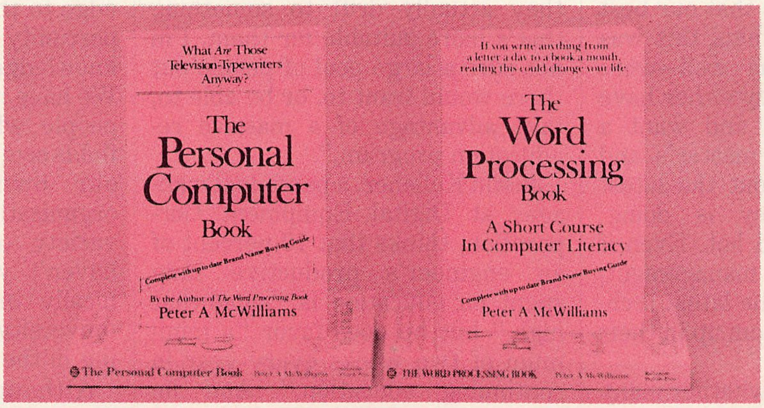
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Philadelphia Inquirer: "By far the best seller in the field, with cause. McWilliams is truly witty on a bewildering subject."

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Do those in industry and others in engineering education think it's necessary? Boston University professor Jack Lynch, who coordinated an earlier industry/university program based on video-taped instruction at MIT, isn't so sure about the emphasis on lifelong education. "My experience in the program at MIT was that our best participants—and I think this was true at Stanford as well—were young engineers. They either have a bachelor's degree and want a master's or have a master's and want to find out about the latest thing their company is doing. These people are red hot. Even if they're going into management, they want to know the latest technology so they can zoom up in their companies."

Lynch also doubts whether many older engineers want to be reeducated. He claims, "There's a real personality issue here. The best engineers get turned on by solving puzzles. They like the activity of the work itself. The other people tend to see engineering as an avenue into another kind of job. Whether it's operations maintenance, management, marketing, or what have you, they're using their technical backgrounds, but they actually drift to something that's more suitable for them. I'm not sure a large pool of people out there would want to, or be able to, take advantage of a massive reeducation program."

Justin Kelleher, a personnel manager at Digital Equipment Corporation, thinks that 10 percent of an engineer's productive time spent on education is "somewhat high," but he does favor "a minimum of two weeks every year in continuing education." And he believes that DEC already does a good job in supporting continued growth among all its employees and in industry/university relations. "We provide a tuition-refund program for our employees and encourage universities to give degree-related courses at our facilities. We also have a residency program in conjunction with a number of universities in which our senior engineers bring industrial knowledge to the campus and get an opportunity to refresh their own knowledge of the latest technology. We have regular seminars in which people who are experts in their fields come to lecture. And we have our own educational-services organization that has developed a variety of specific courses. We haven't yet developed any technically oriented courses with a university, but I do see that coming in the future."

Although Hewlett-Packard's Terry Gildea is enthusiastic about the MIT proposals, he feels that his company is already doing a good job. "All our engineers recognize the rate at which new knowledge is being generated, and they spend a substantial fraction of every working week keeping up on that stuff. We don't have any numbers on exactly how much time our people spend because they're not required to account for it, but if it's not well over 10 percent, I'd be surprised."

Lifelong Education for All?

I'm not sure whether the MIT Centennial Study Committee will find the consensus it needs for a national lifelong-education initiative, but I have a selfish reason for hoping that the effort is successful. I think it could have a big impact on the rest of us. What's the use of having advanced technology if we're not using it well? If the average person can't use technology effectively, how will our economy remain competitive? And if we don't understand technology, how can we control it? Everyone in our society needs lifelong education to keep pace with technology. If it becomes the norm for engineers, maybe the rest of us can get the education we need as well. □

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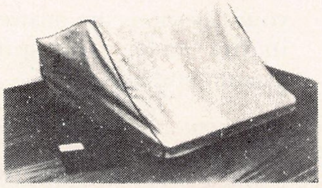

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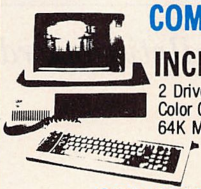

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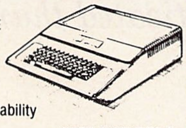

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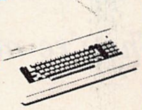

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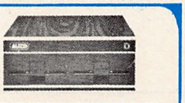

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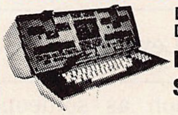

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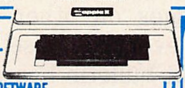

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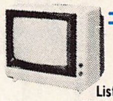

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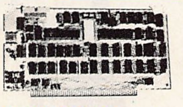

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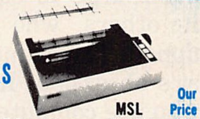

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Conference Trees

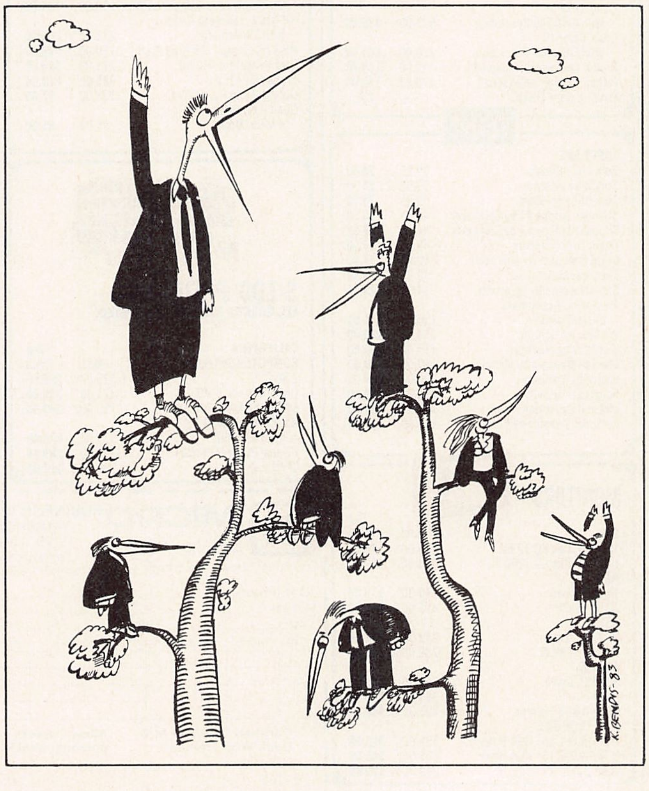
They're more sophisticated than electronic bulletin boards, and more fun too

by Steven Levy

As soon as someone has a computer plugged into the wall and a modem coupled to the phone line, there arises the inexplicable and ultimately uncontrollable urge to establish contact with others who are similarly equipped. This is more than a hobbyist's obsession. Indeed, those of us who use computers for pleasure in these early days are implicitly voting for the kind of future where digital technology will, in some way, improve our lives by simplifying communication with others. We feel it's only natural to get in touch with each other over a network, if only to swap clues on the solution to Wizard and the Princess.

Two basic sorts of networks are in use today. One involves hooking up to a pay-for-connect-time service like The Source or Compuserve. These are the supermarkets of telecommunications, and the electronic aisles are filled with goodies. Both systems offer users the chance to meet via big mainframe computers that handle thousands of callers every day.

The other sort of network involves roughing it a bit, but it's a rewarding kind of hardship, like camping in a national park. With only a list of telephone numbers as your guide, you plunge into the computer underground, a grass-roots network of tiny systems. E. F. Schumacher, author of *Small Is Beautiful,* would have swooned with joy at this phenomenon: hundreds of self-appointed systems operators—Sysops for short—operating their own mini-networks, acting as local electronic clearing houses for public notices, messages, and sometimes lively discussion. These arrangements are fully decentralized, although there is plenty of cross-fertilization as many users regularly access several systems. When they find a lively system, they often leave messages on other systems, and soon everyone else knows about the hot bulletin boards in town. In a similar way, an individual is able to learn of a board that might address some specific interest, like IBM computing or astronomy.



Best of all, most of these boards are free. Let me say that again, free! Keep your relationship cozy with Ma Bell and you can connect all you like.

To date, most of these systems operate on software that emulates a literal bulletin board. Once you log in, you're asked for your name, where you live, and maybe your phone number. (One system asks for your social-security number, and if you give it, the computer ridicules you for being such a gull—why give your social-security number to an absolute stranger?) Then you can get to the meat of the system, which is usually in message form. Some-

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times a board will offer features, little articles about various subjects, or perhaps a screed from the Sysop.

No doubt about it, those boards can be a lot of fun. I've used them to swap messages with folks, to seek out sources for stories, and to put a digital ear to the rails of home computing. But lately I've discovered a supplement to board-hopping that seems organically suited to the implicit ideological leap of amateur telecomputing: tree-climbing.

These computerized *trees* are similar to bulletin boards in that they are privately run, user-oriented, and usually discovered by the same vague word-of-mouth process as the boards are. But the structure is different, and the aims of the tree seem to be oriented more toward discussion than message-swapping. Even more than the users of bulletin boards, tree-hopping enthusiasts insist that they are at the forefront of some near-revolutionary movement.

Up a Tree

I remember the first time I accessed one of these conference trees. After my screen went blank save for the blinking cursor (the sign that I had connected with a computer willing to speak to me), I supplied the requisite carriage return and was greeted with "Welcome to the conference tree. Type 'Read Help' any time or 'Read Conferences' to start."

It was refreshing not to be hit with a lot of questions about my identity, as if I were trying to pass an out-of-town check. I typed "Read Conferences," and a list of subjects with dates ranging from the beginning of the year to a few days before appeared on my screen. Over one menu was a legend that read, "This conference is devoted to the computer language FORTH." For those of you who aren't up on the polemics of computer languages, FORTH is rather controversial. Its supporters extol it as the Ultimate Solution, elegant, versatile, and efficient, but skeptics sniff at the FORTH-oids as disciples of a cult.

In any case, as I asked to read this conference or that, I was impressed by the structure of the system. Like a tree, it began with a trunk—the main menu of conferences. Each conference was a branch, an opening salvo designed to state some opinion or introduce some startling fact. Those who accessed the tree had used the command Addto to make a branch from that branch, and so on. By following branches, you could trace the give-and-take of a heated discussion, full of yes-buts, hold-on-heres, well-puts, and you're-full-of-its. Ultimately, the branch ends with the anticlimactic "No Submessages," at which point the user may provide his or her own capper or return to the trunk or a previous branch.

Not being a FORTH programmer, I found that the dense foliage of jargon made climbing this particular tree rather arduous. I did catch some of the idealistic flavor of FORTH-mania in branches dealing with the language's ethics and standards. I finally settled on a branch called Humor, where I accessed a sub-branch that turned out to be a tale in progress called "The Merry Misadventures of Murdock the Programmer." Though the point eluded me, I was amused at Murdock's fairy-tale travels in a land where a princess is described as "the loveliest piece of software" Murdock has ever beheld. Each few paragraphs would branch out to the next chapter.

After reluctantly leaving Murdock, I returned to the base of the Humor branch and chose the option titled, simply, Joke. The anonymous author of this branch apparently had entered a series of Control-G characters into the message. In the BASIC language on an Apple, a Control-G produces a beep. I don't do this at home because I don't like the sound, so I was not pleased when the "joke" resulted in a seemingly endless series of beeps. What was even worse was that I had been capturing this session with my printer, and the content of this "joke" triggered the sound that the printer makes when it runs out of paper or is about to explode. This resembles the noise in a submarine about to make an emergency dive. It's the kind of sound that takes a few years off your life, especially when you can find no way to stop it. I had to turn the computer off.

Later I reaccessed that branch and found a submessage to the "joke." It read, "Some people have no sense of humor." Maybe I'm one of those humorless folks, because I think people who enter beep commands into other people's computers should have their modems confiscated.

Communitree

Despite the abrupt climax of my first session, I vowed to learn more about these trees, a quest that ultimately led me to the San Francisco office of Dean Gengle, one of the founders of the Communitree group that created and distributes Communitree software. Dean, a rather intense fellow who has long pondered telecommunications issues, had been involved with bulletin boards for a few years when he and some friends decided that something more was needed. What they had in mind was something that would appeal not only to computerists but also to people in general, especially people interested in community activism. The group set out to create communications software that would work, says Dean, "from the grass roots up as a tool for creating information."

One member of Dean's group was John James, a key figure in the FORTH movement. John wrote the code for the Communitree software using, what else, FORTH. The idea was to create a system that was as accessible and democratic as possible. Only three

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Columnist Steven Levy is a contributing editor of *Popular Computing* who lives in New York City.

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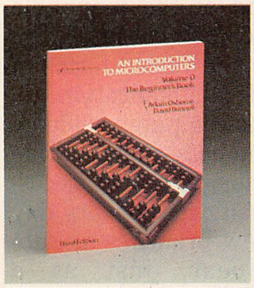

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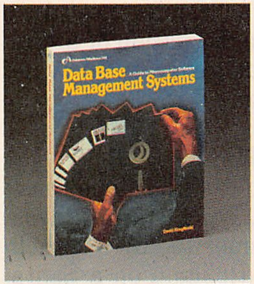

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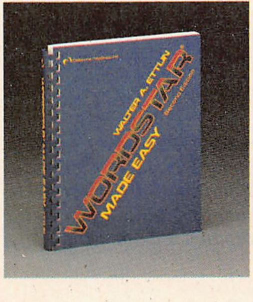

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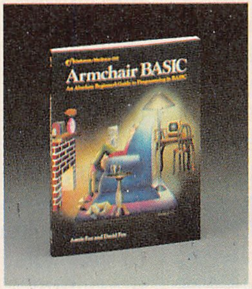

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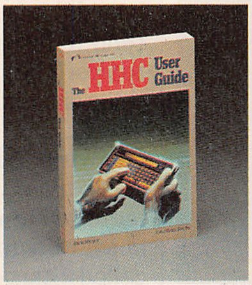

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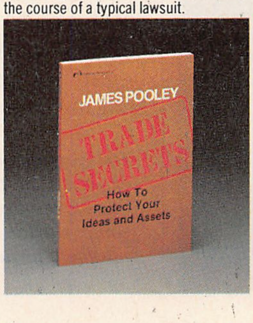

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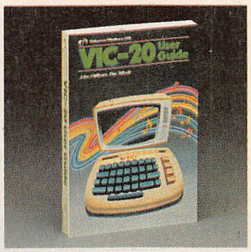

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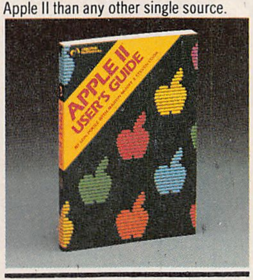

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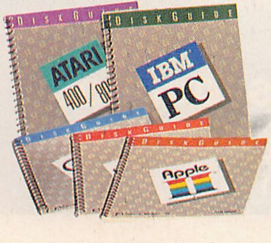

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James began writing the software in mid-1980, and by March 1981, the first two trees had sprouted in San Francisco and Berkeley. While the Berkeley tree naturally harbored some political discussions, the network across the bay focused on telecommunications issues (and still does). "We talked about data security and how power can be shaped by a big company's decisions," says Gengle. "We're also interested in personal security and cryptology."

The distribution of software also followed Communitree's techno-activist bent. "Our idea is to seed the country," Gengle reports. "It's the Timex/Sinclair $99-computer strategy. Get them out there for as little as you can and people will want more." At $250, Communitree software plus the requisite support isn't exactly cheap, but consider that it can make anyone with an Apple II and a couple of disk drives into an instant information utility.

Intellectual Communications

Not surprisingly, the Sysops who are attracted to Communitree software share in the vision of a decentralized, freewheeling communications future. For instance, Stanley Beckerman, a 35-year-old financial securities analyst, sees himself as "an adjunct to the future" by running a conference tree from his home in Denville, New Jersey. He has designated his Apple as a full-time tree and has connected it to its own separate phone line.

"It's not my first attempt at this," he says. "I started with bulletin-board software." But Beckerman now sees those systems as "little message boards where people leave cutesy information." What changed his mind was a visit via modem to the original San Francisco conference tree. "It was a lot clearer for users. I liked it so much that I contacted Dean Gengle."

In the seven months since the New Jersey tree has been planted, Beckerman has entertained almost 2000 callers. He spends a few hours a week "pruning" the tree, deleting outdated notices or comments and getting rid of the inevitable obscenities. Generally, though, he is delighted at the varied forms of discussion and communication going on inside his computer while he works, while he eats dinner, while he sleeps. Although it's not necessary, Beckerman checks every day to see what new branches or submessages appear, just as a gardener checks a tree growing under his care.

"There's a higher level of shared information here than on a bulletin board," he says. "Conference trees tend to foster a discussion of useful topics. They can generate fairly intelligent dialogue."

Growing Wild?

It's true, you can find some rousing discourses. For instance, I was absolutely mesmerized by a branch called Start-A-Religion on a Santa Cruz, California, tree. (Titles of branches must be single words, but a word can be hyphenated—it also boosts readership if your title is a catchy one.)

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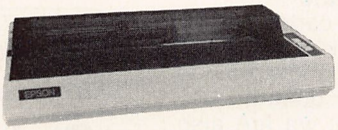

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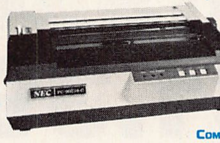

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This anonymous manifesto generated 27 submessages, many with branches of their own. Some were from doubters of this new religion: "Your basic tenets overlook basic ingredients for any and all religions." Other submessages were seemingly from supporters, but because the founder of this religion didn't sign his or her missives, it was difficult to tell how many different supporters were entering branches.

In any case, the discussion ranged from recruiting techniques to some serious probing of the issues of existence. And every time things got too serious, someone would branch out with a "Yarggh, snurf, yegh, and bah humbug too." ("That is good," responded the Founder in a submessage. "Opposition shows that the energy is there.") All in all it was an entertaining find, a lively colloquy that had been going on for months.

That was a particularly successful branch; other efforts at long abstract discussions often seem to fall flat. On several trees, for instance, I've explored branches titled something like Political-Info only to find that invitations to express views on politics have elicited only a very few submessages. Even Peacenet, the tree operated by peace activists, seems to have a problem generating substantial debate about tactics for a nuclear freeze. "Politics and current events are two branches I haven't been able to get off the ground," admits Beckerman. "To get a good branch going, you have to hit the right hot button for the group."

Different trees have different favorite branches. On the Communitree flagship in San Francisco, a branch called Forestworks is almost like an interactive magazine of amateur telecommunications. On many other trees, including Beckerman's, people gossip about the computer industry and argue the worth of a given piece of software. (I've noticed dueling branches about the value of Wordstar, for instance, with detractors insisting that its command structure is clumsy and awkward while supporters defend it to the death.) Almost every tree has some section of random graffiti or humor, and these are often the most frequently accessed.

On some trees, the humor can get out of hand. For instance, when you type "Read Jokes" on the Atlanta tree, you're offered a list of jokes on subjects entitled:

1. Dead Baby
2. Polish
3. Black
4. Gay
5. Religion
6. Animal Jokes
7. Jewish Jokes
8. Girl Scouts
9. Helen Keller Jokes
10. Sexual Jokes
11. Christmas Story
12. Terminal Advice
13. Higher Math
14. Ugly!!
15. Chinese Jokes
16. Miscellaneous Jokes

So much for consciousness-raising from the grass roots!

Also on the Atlanta tree is a lively sexual conference with a well-placed warning that "this branch is intended for mature, responsible users only and may contain graphic or explicit language or depictions of sexual matters." If you type "Read Hotstuff," you'll see why the warning is needed. A tale unfolds that would put the *Penthouse* letters section to shame. Interestingly enough, the opening branch of Hotstuff had 345 readers, the branch that continued the story was read by only 234, and the branch after that, supposedly the hottest stuff of all, found only 186 readers.

How to Call a Tree

Here are numbers of systems that run under Communitree software. Any computer with the software and a modem can access them. When you receive the carrier signal, hit the carriage return and you're on. Typing "Read Conferences" will give you the trunk; you can then access the branches.

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(408) 475-7101
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(213) 394-1505

If you are interested in planting your own tree, write to The Communitree Group at 470 Castro St., San Francisco, CA 94114.

Forests of the Future?

The point is that any conference tree offers plenty of variety, a chance to interact with other computer users, and a price that certainly can't be topped. Dean Gengle envisions a future where much of our intellectual and social exchange will be handled by a proliferation of trees. "I see one tree for every hundred computers," he says—quite a jump from the 200 or so trees operating today. While I think that Gengle's is a rather optimistic outlook, I do find it in keeping with the wonder and excitement that many tree-people seem to feel about the technology and its promises. It's definitely infectious.

Still, I wonder about the discrepancy between the hundreds or even thousands of people who access the trees and the mere dozens of branches found on them. The least-used command seems to be Addto, and I've noticed how much easier it is to swing from branch to branch like an electronic Tarzan without adding comments of my own. Are trees just the telecommunications equivalent of talk shows, somewhat more unbridled and lacking only the celebrity drop-ins? I certainly hope not. With the easy opportunity to comment or indeed to start a branch (or a religion!) of your own, it would be a real shame to let this chance for expression go to waste. ☐

Author's Note—Steven Levy welcomes your comments, hints, and suggestions about telecomputing. You can contact him on The Source (ID TCT670), Compuserve (ID 72065,635), or by writing to Telecomputing, POB 397, Hancock, NH 03449.

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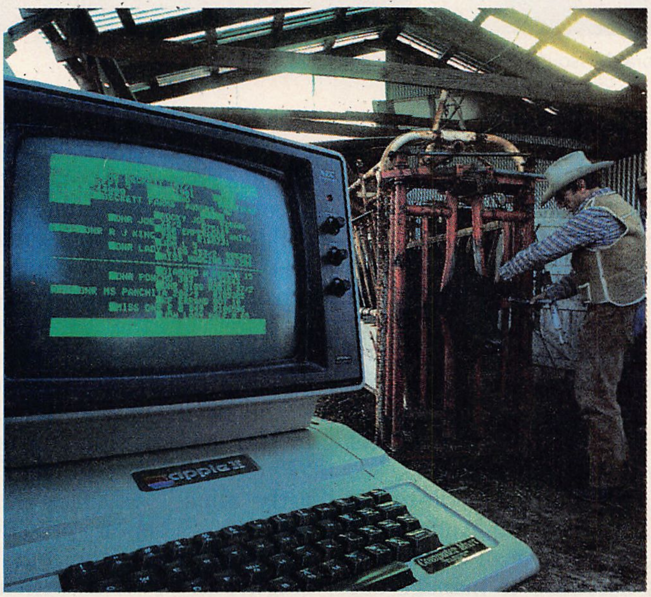
COMPUTERS ON THE FARM

Micros help even the odds for the family-run farm.

by Andrea Kaminski and Larry McClain

"Today's farmer is similar to the Dust Bowl-era farmer in just one respect," says L. Bert Kinchloe, a computer dealer in western Kansas. "Both faced a dismal economy. Otherwise, there's no similarity whatsoever. A lot of my customers are college-educated and don't wear bib overalls into the store. They're sharp business people and, believe me, they have to be alert to survive."

Dozens of hardware and software dealers nationwide would agree with Kinchloe's observation. In the last three years, as the farmer's real income plunged to its lowest level since the Great Depression, the line denoting on-farm microcomputer sales has kept arcing upward. "We find that, due to the recession, farmers are seeking us out just as much as we're seeking them," notes Donna Faulks, head of client services at Ag Data Systems in Gridley, California. "There's more enthusiasm on family-run farms than on corporate-run farms," she adds. "We're working with a lot of young farmers who have convinced Dad that the microcomputer is the survival tool they need."



Sire Software: Today's farmer is a painstaking record-keeper. This Apple II is used to update breeding data.

As Kinchloe attests, the farmers buying these computers are shrewd business people who use their systems for a variety of applications: enterprise analysis, double-entry bookkeeping, least-cost feed programs, animal health records, and more.

Profile of the '80s Farmer

Today's farmer still spends his time and money much like his predecessors in the pre-micro days. Because farmers are accustomed to shelling out $50,000 and more for tractors and combines, they don't get woozy when the salesman starts talking about a $4000 microcomputer system. "Farmers are good at taking the long-term view," says Marianne Randolph, co-owner of Harvest Computer Systems in Alexandria, Indiana. "They learned many years ago that you don't save a nickel by buying a cheap tractor and having to trade up each year for more horsepower. In short, the farmer isn't afraid to tell the salesperson, 'Three years from now, I'm going to need a bigger computer system.' "

"I really don't see where computers have changed the daily routine on the farm," Kinchloe offers. "In most family-run farms, usually one person handles the accounting and record-keeping, which leaves the others free for chores and errands. The decision to buy a computer for the farm is very seldom a unilateral move. It's a group decision—quite often a husband and wife purchase."

Randolph notes that "through mid-1982, most of our customers were in the 30-to-40-year-old bracket, but since then we've been getting numerous calls from

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Andrea Kaminski is a freelance writer based in Madison, Wisconsin. Larry McClain is a staff writer for *Popular Computing*.

Photographs by David Burnett/Contact

John and Melissa Beckett of Aurora, Missouri, keep accurate records on their 350 head of cattle.

farmers age 40 to 60. You really can't assume that age has anything to do with receptivity to new technologies."

Arthur Stiennon is a "triple threat"—a radiologist, farmer, and president of a software house called Wisconsin Microware. He owns and manages 23 farms in south-central Wisconsin and has written more than 250 programs for the Digital Equipment Corp. PDP-8/L minicomputer (many of which have been adapted for the Apple II by his software firm). "A microcomputer can pay for itself in a single day," Stiennon maintains, "if it helps the farmer make the correct decision about what to do with barren beef cows."

Bob Anderson's TRS-80 Model II is rarely idle on his dairy farm near Oshkosh, Wisconsin. Anderson's bookkeeping and accounting tasks are all computerized, and he uses data-entry software to manage 500 acres of cropland. He also maintains detailed pedigree, health, and breeding records on each of his 90 dairy cows.

Bonnie Craig relies on the TRS-80 Model I to update payroll and accounting records on his 1500-acre ranch in the heart of Oregon. Craig took several programming courses in college and was therefore able to modify off-the-shelf accounting software to fit his needs.

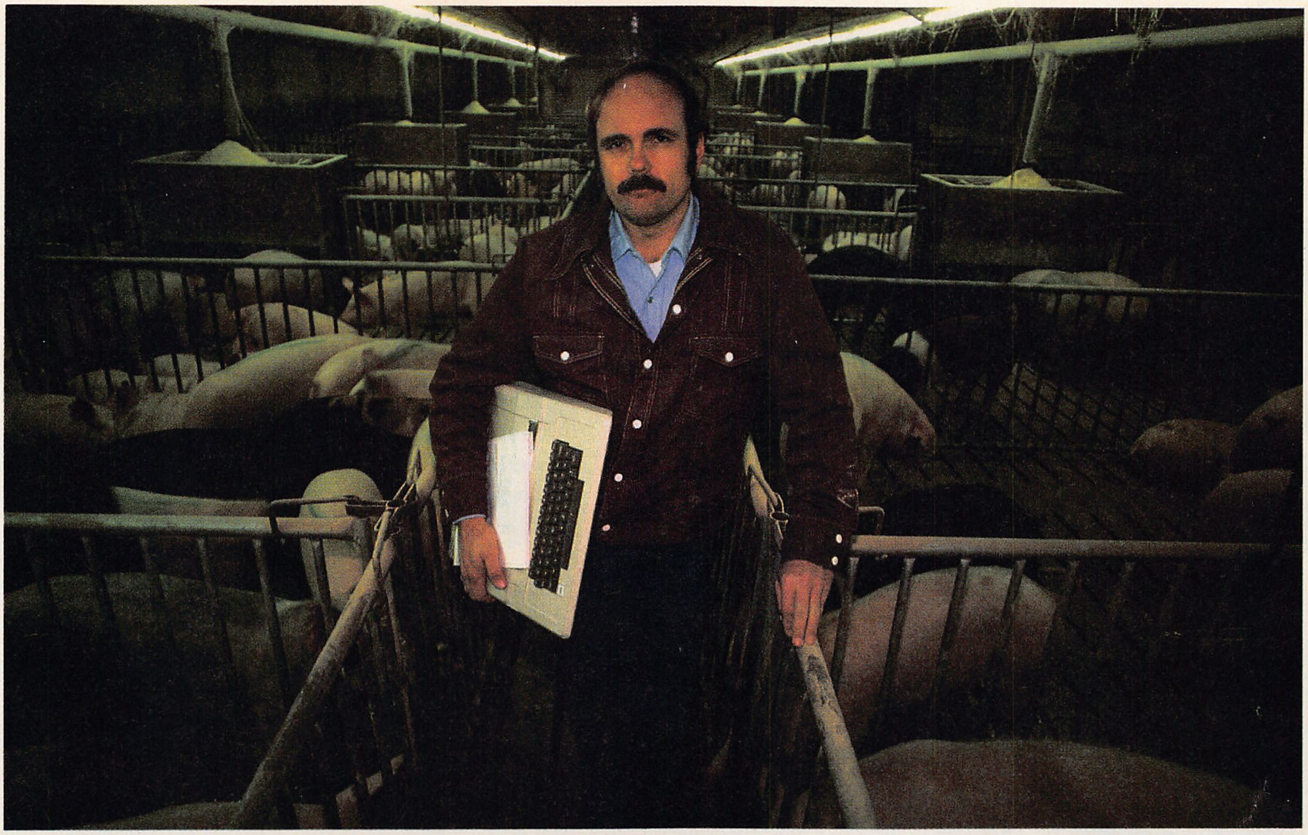
Some Tricky Applications

Farmers are just now discovering that it takes outstanding software to make a microcomputer do what their co-op extension's mainframe has done for the last 10 to 15 years. Sometimes the farmer really needs only a terminal, not a full-fledged computer. "If you're looking for nutritional advice for a certain size herd, all you really need is a dumb terminal to access your extension's mainframe," says Ben Coplan, marketing director of the Holstein-Freisian Association of America, a Holstein breeder organization headquartered in Brattleboro, Vermont.

Things get much tougher, of course, when the farmer has to plug in his own numbers every day. "I've never heard of two farm operations that are exactly alike," chuckles Randolph. "More and more farmers are beginning to do double-entry bookkeeping using the computer, but the majority still prefer a single-entry system with a few pluses. That's why we have a 48K-byte accounting package for both the Apple II and the IBM Personal Computer. That amount of memory just wouldn't be enough, though, for double-entry systems."

Ag Data's Faulks scoffs at the idea of a 48K farm accounting package. "Our programs maintain year-to-date details," she explains. "Therefore, if you have, say, 700 transactions a month for 11 months—plus file backup—you need more than 140K bytes of disk capacity to store all the data. A hard disk is advisable if not essential."

Faulks stresses that computerized farm accounting



Bob Johnson of De Kalb, Illinois, uses his Apple to formulate the most economical mixture of feeds for his livestock.

is exceptionally tricky, with jargon all its own. The least-cost feed program, for example, is software that determines the cheapest and most nutritious blend of anywhere from 50 to 100 ingredients. Most computer retailers don't even know what the program *does*, let alone which one is best.

"Farmers need a little more hand-holding than other small-business people," says Faulks. "Our role is to brief the hardware dealers on the basics of farm cost-accounting and to acquaint them with the terminology."

Too often, farmers discover that off-the-shelf software comes tantalizingly close but doesn't exactly meet their individual needs. This is especially true of "enterprise analysis" software—programs that compare input quantities to output quantities so the farmer can learn, for instance, how many gallons of fuel it takes to yield a pound of beef. "The ideal situation is to have an experienced programmer in the store who can make the modifications," says Kinchloe. "It's usually just a matter of a line here and a line there, but it's been my experience that most farmers don't give a hoot about programming. They're interested in the results and generally don't care all that much about learning BASIC."

"Some retailers might innocently sell dBASE II or Condor or other relational databases for the purpose of animal record-keeping," says Alvin Kay, sales manager of Agricultural Software Consultants in Kingsville, Texas. "Those packages will work, sure, but in many cases they're too involved for the average farmer to use easily."

Why the Software Lag?

So how come first-rate agricultural software is as rare as a bumper wheat crop in the Soviet Union? Stiennon argues that few programmers really understand the complexities of the modern farm. "You could be a mathematical wizard and a fine programmer," he asserts, "but you'll fall flat on your face if you overlook some very simple things that anybody on a farm knows."

Coplan sings those off-the-shelf blues: "Most agricultural software is an adaptation of existing business/accounting packages. The dairy enterprises are much more record-oriented than cattle or crop farming, but you'd never guess that looking at the available software. The only package I'm aware of that addresses the dairy applications is the one written by a dairyman and being marketed by IBM for use on the Datamaster and the IBM Personal Computer." (The package is called Dairy Cow and Herd Health Management System, written by Mississippi farmer Bobby Hall.)

One reason why software distributors haven't gone gung-ho in the agricultural market is that the farmer, unlike most other small-business people, isn't shopping for a cornucopia of software. Word-processing

Instant Commodities News: Farmers use computers to keep posted on commodities trading. Tomorrow's newspaper isn't good enough.

packages don't light a fire under most farmers. "Farmers don't write many business letters—not yet, anyway," says Harvest's Randolph. "After two or three years of working with the computer, that all could change, though."

Faulks is dismayed when farmers let computer dealers sell them hardware prior to software. "We've had a few instances when the farmer walks in to buy one of our packages only to discover that the machine he bought doesn't even have enough disk capacity to run it," she sighs. "And very few farmers are knowledgeable enough to ask about operating systems. CP/M offers the widest selection of agricultural programs."

The scales will indeed shift to CP/M if farmers continue to buy Kaypro II portable computers as fast as they did in 1982. "The Apple II and TRS-80 Model II established a quick lead, but last year many of our clients bought Kaypros," says Agricultural Software's Kay (no relation to the inventor of the Kaypro II). "Consultants and veterinarians spend a great deal of their time on the go from farm to farm," he adds, "and the Kaypro II really appeals to them."

The "What Else?" Syndrome

Most families buy their first computer for the fun and glamor of it, then proceed to the serious stuff. Farm families, however, are just the opposite: they have a rock-solid, pragmatic reason for making the purchase. They gradually loosen up and have more fun with the machine. "They succumb to the 'what-else?' syndrome," says Randolph. "Eventually they start asking, 'What else besides farm accounting can this machine do for us?' "

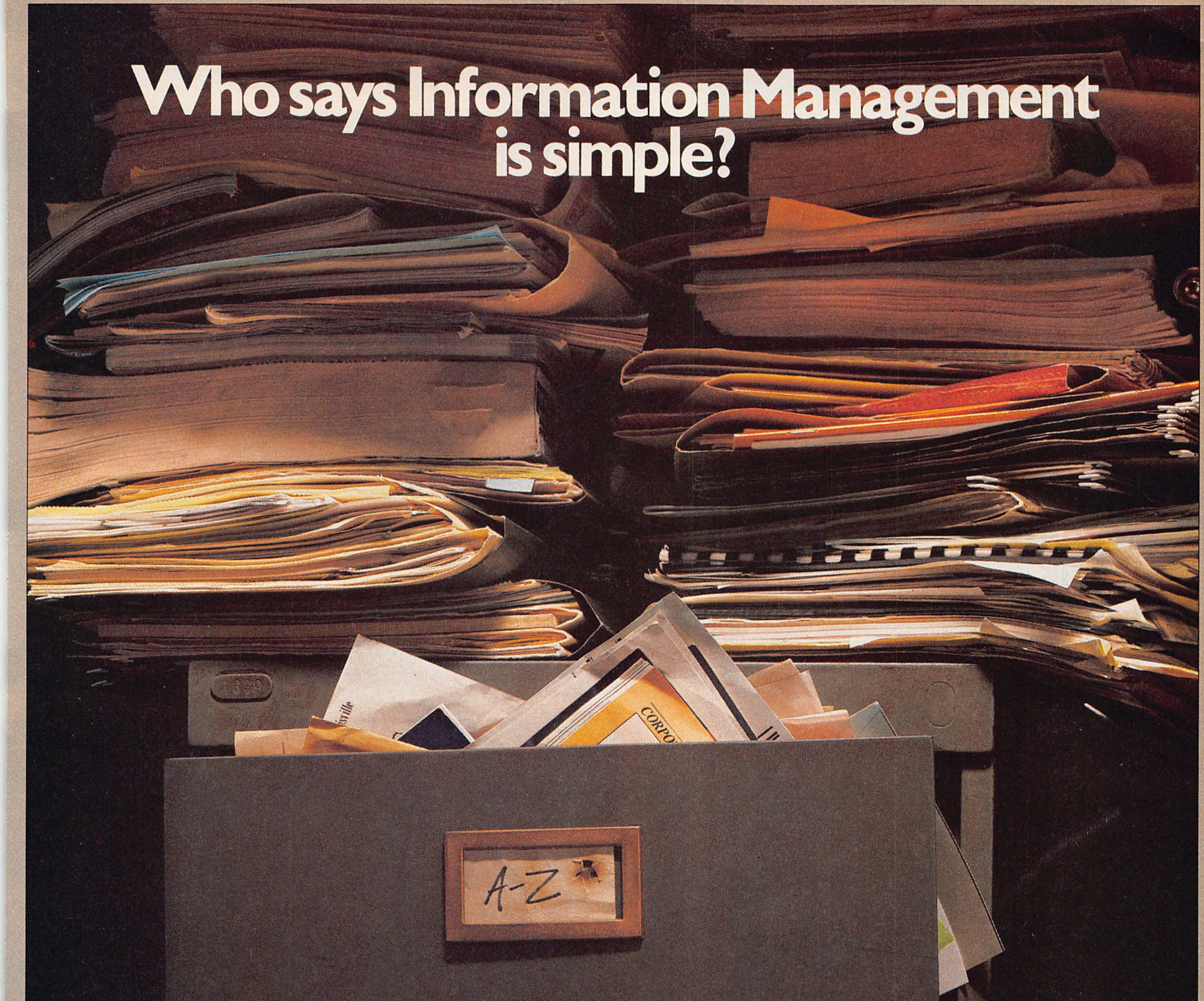
Faulks predicts that farmers will get hooked on telecomputing once they feel comfortable with the computer: "As soon as they feel confident running their herd-management programs and their feed-rationing programs, they're going to start playing around with Dow Jones and The Source.

"In 1980 our computer demos were a big novelty at the farm equipment shows," Faulks continues. "But now we're getting mobbed by 400 or 500 people at each presentation. This may be a by-product of our being in California, one of computing's vanguard states. All I know is that, in the last 24 months, a lot of farmers have gotten vitally interested in personal computers."

In 1883, farmers referred to the Colt .45 as "the Great Equalizer." A century later, the microcomputer looms as the farm family's Great Equalizer, the tool that could turn the little guy's confrontation with OPEC, the U.S. government, and greedy middlemen into a fair fight again. □

PHOTO © 1982 TJK

Who says Information Management is simple?



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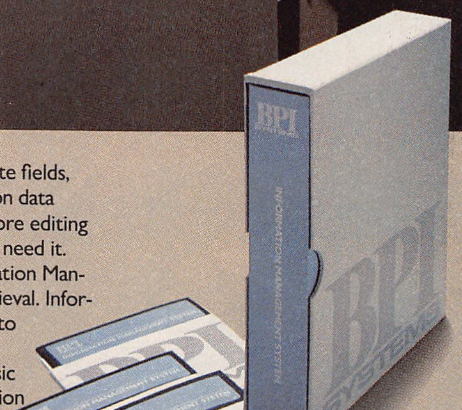
The BPI Information Management System automatically edits your entries for proper format of numeric, alphanumeric and date fields, thereby preventing the most common data entry errors. You can even define more editing criteria whenever and wherever you need it.

The real power of the BPI Information Management System is found in data retrieval. Information in any field can be compared to other fields and displayed in seconds. Since the system performs all the basic math functions, you can see information expressed in percentages, rank order, alphanumeric sequence, or even as graphs. And you can switch formats with the stroke of one key.

This system can even automatically retrieve information directly from BPI's accounting systems.* And BPI's password security protects your sensitive material.

The BPI Information Management System is a tool which enables you to do the things you always thought a computer should do. It's just that simple.



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The TRS-80 Model 100

by George Stewart

M7I1E,10
Telcom: Call 9-
Calling 91817
Find Call Stat
F1
F2
F3
F4
F5
F6
ESC
TAB
CTRL
CAPS LOCK
SHIFT
GRPH

It's no secret that a grueling race for supremacy in the portable computer market is about to begin. In fact, experts predict that when the dust settles this may well be remembered as the year of the portable computer. But so far, despite all the promotion, only one portable can make any claim to the pole position as a clear favorite: Radio Shack's new TRS-80 Model 100.

It is the first portable computer we've seen that's both practical and affordable. With the exception of a printer, it offers all the features you need in a portable computer—telecommunications, word processing, programmability—all in an attractive 3½-pound package that lists for $799.

Despite its small size, the AC- or battery-powered Model 100 (which should be in all Radio Shack stores this month) is equipped with a typewriter-quality keyboard, a stunning eight-line liquid-crystal display, and up to 32K bytes of random-access memory (RAM) that holds its data even while the unit is turned off. Built-in interfaces for

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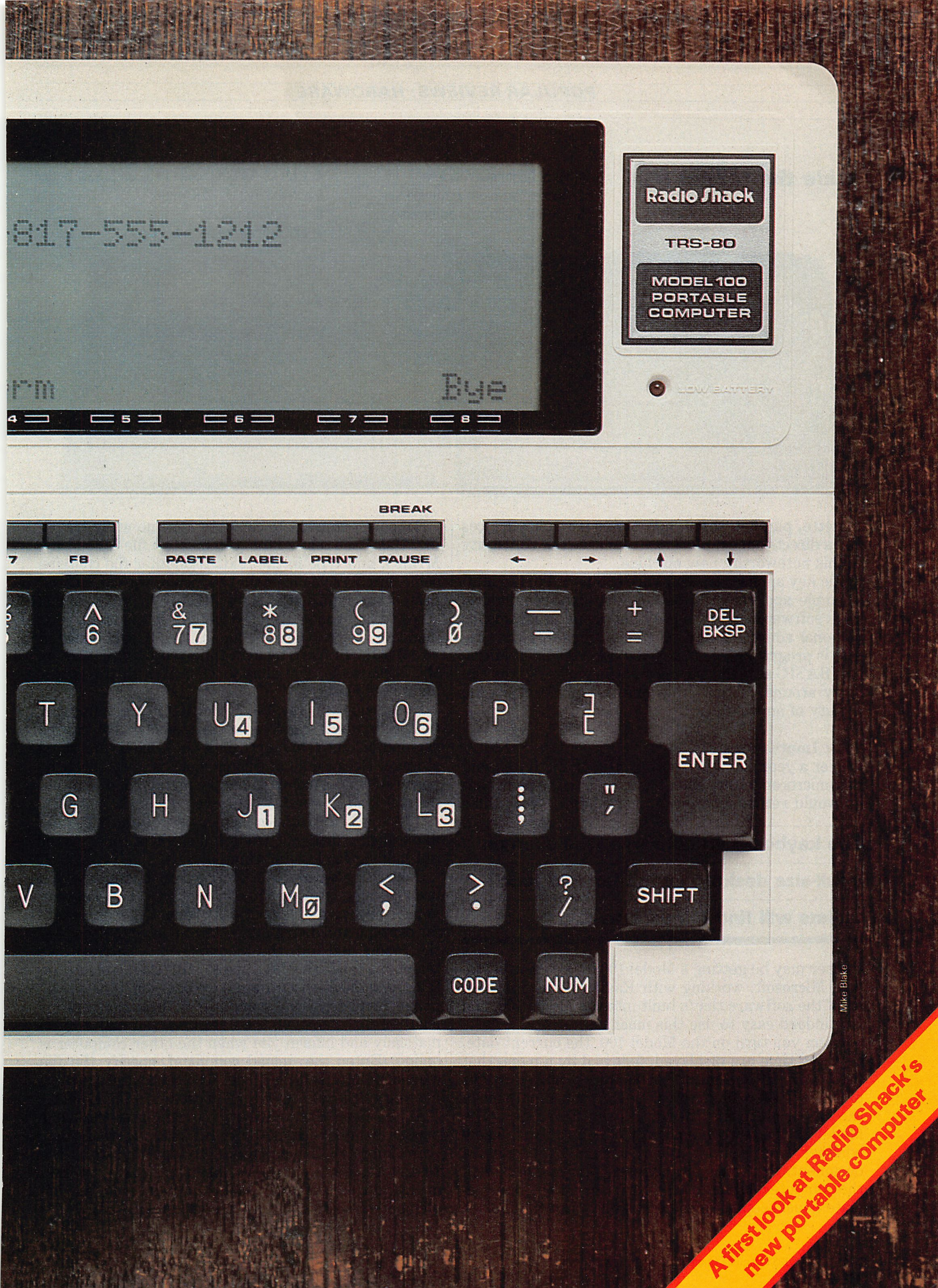
George Stewart is senior technical editor of *Popular Computing*.

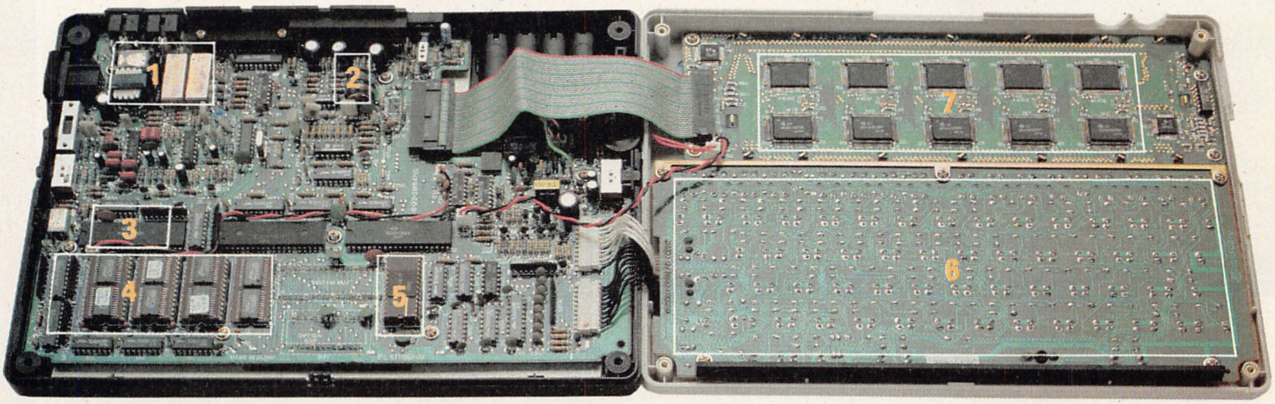

817-555-1212
rm
Bye
Radio Shack
TRS-80
MODEL 100
PORTABLE
COMPUTER
LOW BATTERY
BREAK
F8
PASTE
LABEL
PRINT
PAUSE
DEL
BKSP
ENTER
SHIFT
CODE
NUM

A first look at Radio Shack's new portable computer

Mike Blake

Inside the Model 100

1 Direct-connect modem
2 Nickel-cadmium batteries
3 CMOS 8085 microprocessor
4 CMOS RAM (shown here with 32K bytes)
5 CMOS ROM, 32K bytes
6 Keyboard matrix
7 LCD driver chips



cassette, parallel, serial, and bar-code-reader devices and a direct-connect modem all enhance the versatility of this noteworthy new machine.

The key applications software is integral to the unit: a simple and versatile text editor, data communications software, and two small but useful programs for personal addresses and schedules. Furthermore, the unit is programmable in a souped-up version of Microsoft BASIC as well as in machine language, so you can carry around custom programs that perform a wide variety of applications.

First Impressions

Over a year ago, Microsoft president Bill Gates said that microcomputers hadn't advanced to the point that he would recommend one to his mother. Well, Bill's mother may be getting a Model 100 for her next birthday. Microsoft, working with Radio Shack, produced all of the software that's built into the Model 100, and it is indeed easy to use this machine.

The keyboard would serve well even on a full-size desktop computer, and touch-typists will find it a snap to use.

When you turn on the Model 100, the current date, day, and time are displayed, followed by a menu that lists program and data files currently stored in the unit. To select a file from the menu, you simply move the cursor to it and then press the Enter key. The Model 100's menu system doesn't require you to know whether your selected file is a BASIC program, a document, or a machine-language program. Instead, the computer automatically performs all the intermediate housekeeping needed for you to use the file.

Suppose you want to compose a memo while traveling. Using the text editor, you create a file called, say, MEMO, and type in the text. If another file contains some numbers you need for the memo, you can cut and paste that information into MEMO in a few quick steps. When you're through, you press the Menu command key to return to the menu. MEMO will be listed as a document file. The next time you wish to work on the MEMO file, you simply select it with the cursor and press Enter.

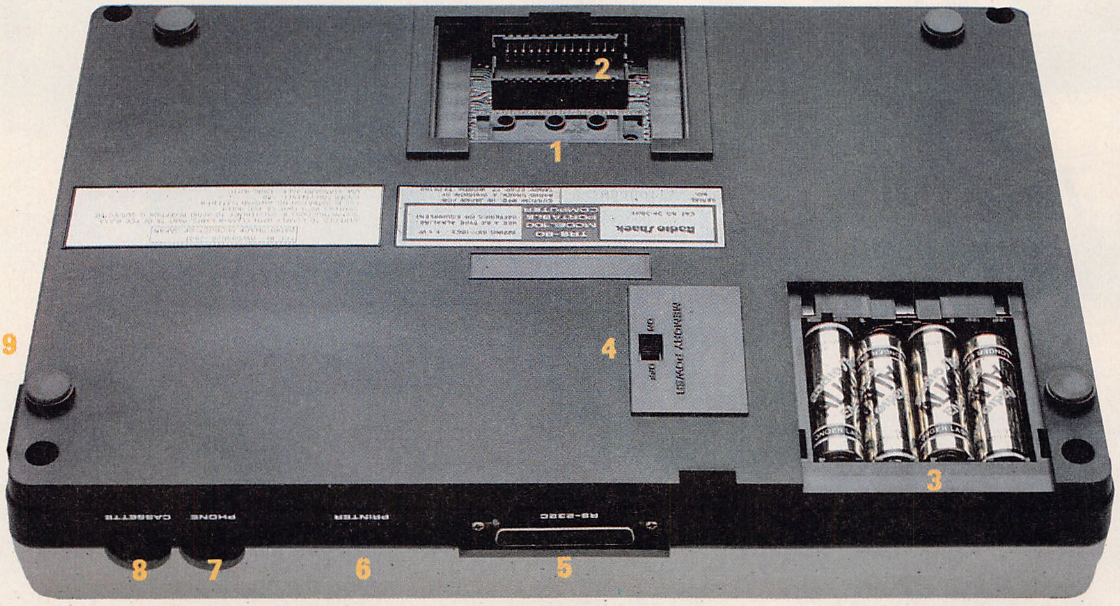
Files, you say? Yes, the Model 100 contains from 8K to 32K bytes of random-access memory that can be segmented into distinct files and used for mass storage. Because all of this memory is of the battery-powered CMOS (complementary metal-oxide semiconductor) kind, it retains data even while the power is off. In short, the built-in memory saves and files data like a floppy disk, operating hundreds of times faster but holding far less information.

Continuing with our MEMO example, suppose you are visiting a customer in a distant city. You can send your memo, prepared on the airplane, to headquarters for printing and distribution. All you have to do is plug the Model 100 into the telephone line between the telephone and the wall jack and then select the telecommunications program. When you type in the phone number of the computer at headquarters (or load it from memory), the computer will dial it automatically and inform you when the other computer is online. Enter the upload command, specify the file named MEMO, and the Model 100 does the rest, returning you to the TELCOM menu after the file is sent.

At the hotel that evening, you can enter the day's expenses into a simple BASIC program that sorts them, subtotals them according to type, and stores the results in a document file. (This hypothetical program is not a Radio Shack product, but it could be implemented easily using the Model 100's BASIC.)

The Model 100 contains room for future enhancements

1 System bus connector for future enhancements
2 Socket for addition of 32K-byte applications ROM
3 Four AA batteries
4 Memory-disconnect switch for long-term storage
5 RS-232C interface
6 Parallel printer interface
7 Modem interface (connects to telephone line)
8 Audio-cassette interface
9 Bar-code reader interface (side panel, not shown)



In short, all the steps involved in text preparation and telecommunication are convenient and easy even for those with no computer experience.

The basic operations are described in plain English, not computerese, in 16 pages of the owner's manual. A 50-page quick-reference manual is also included with the computer. (Both manuals were in preliminary form at the time of this writing.)

HARDWARE

The case of the TRS-80 Model 100 is cream-white on the top and black on the bottom—a pleasant change from the traditional TRS-80 silver-gray and black. Measuring 11¾ by 8½ by 1⅞ inches, the unit is easy to carry in a briefcase. It comes with a soft carrying pouch designed primarily to protect the display surface from scratches. In addition, Radio Shack plans to offer a carrying case with room for a cassette recorder, cables, and other accessories.

Liquid-Crystal Display

The Model 100's liquid-crystal display (LCD) is the largest found on any portable computer—roughly 7⅜ by 2⅛ inches. It displays eight lines of 40 characters each, with uppercase and lowercase letters, foreign-language alphabets, graphics characters, and other special symbols. Every character can be displayed as white on black or black on white. The display can also be treated as a 240 by 64 dot matrix, and text and dot graphics may be mixed on the screen, opening many possibilities for the presentation of charts and graphs.

As owners of LCD watches know, these displays rely on reflected light to produce readable images. It is essential to position the unit carefully for easy reading; glare and inadequate lighting can cause problems. On the plus side, the Model 100 includes an intensity adjustment that lets you optimize the contrast for your particular viewing angle.

Radio Shack evaluated various display sizes—including four lines by 80 characters—before settling on the present configuration as the most readable. For comparison, the average column of newsprint contains 35 characters, so 40 characters is not an unacceptable length by any means. Radio Shack also tried 80-column lines displayed in half—left side and right side—but found this too awkward except for the creation of multicolumn tables. At any rate, the 40-column display is effective and probably the best compromise for a portable computer using today's technology; its only drawback is the difficulty of visualizing the final format of a printed report. Designers of the Model 100 expect, however, that many users will upload the text to another computer before it is printed so that formatting can be done using the word-processing facilities of the larger computer.

CONTINUED ON PAGE 156

Photographs by Mike Blake

NEW!
EPSON
QX-10!
UNDER $3,000!
Personal Computer
Systems Unit

If you just bought another computer,
boy are you gonna be sorry.

Epson.

The new Epson QX-10 is unlike any personal computer you've ever seen. It's a computer for people who don't have the time to learn computers; a computer you can be using within minutes.

And fortunately, you don't have to take our word for it. Here's how *Byte*, one of the computer industry's most prestigious magazines, describes the QX-10.

The first anybody-can-use-it computer.
"The Epson QX-10 (is) a computer for less than $3000 that may well be the first of a new breed of anybody-can-use-it 'appliance' computers ... In addition to being a highly integrated word processing/computer system that offers as much usable processing power as almost any existing microcomputer, the QX-10 ... system is designed to be used by people with minimal technical knowledge. We've certainly heard that claim before, but Epson has delivered on this promise in a way and to an extent that *no* microcomputer manufacturer has done."

That's nice to hear from a magazine like *Byte*, of course, but it doesn't surprise us. It's just what we intended the QX-10 to be all along.

More computer. Less money.
But useability isn't the only thing the QX-10 has going for it. As *Byte* says, "the QX-10 gives you a great deal for your money.

"Help is available at any time through the HASCI (Human Application Standard Computer Interface) keyboard Help key ... Text can be entered at any time just as you would in a conventional word processor. The Calc key turns the system into a basic 4-function calculator. Graphics can be created via the Draw key. The Sched (schedule) key gives you access to a computer-kept appointment book, a built-in clock/timer/alarm, and an event scheduler."

Advanced hardware for advanced software.
As for hardware, *Popular Computing*, another industry leader, says: "The QX-10 includes ... a number of advanced hardware features ... The basic components of the system are a detachable keyboard, a high resolution monochrome display, and a system unit containing two 5¼ inch disk drives. The drives use double-sided, double-density disks (340K bytes per disk) and are amazingly compact ... The QX-10 uses an 8-bit Z80A microprocessor. The system contains 256K bytes of RAM. Some of the RAM is ... battery powered ... which lets the computer retain information when the power is off."

You won't have to wait much longer.
The new Epson QX-10 may very well be the computer you've been waiting for. And fortunately, you won't have to wait much longer — it will be appearing soon in computer stores all across the country. In the meantime, write Epson at 3415 Kashiwa Street, Torrance, CA 90505, or call (213) 539-9140. We'll be happy to send you copies of our reviews.

After all, as *Popular Computing* puts it, the QX-10 will "do for computing what the Model T did for transportation."

And we couldn't have said it better ourselves.

EPSON

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COMPUTER PRODUCTS DIVISION

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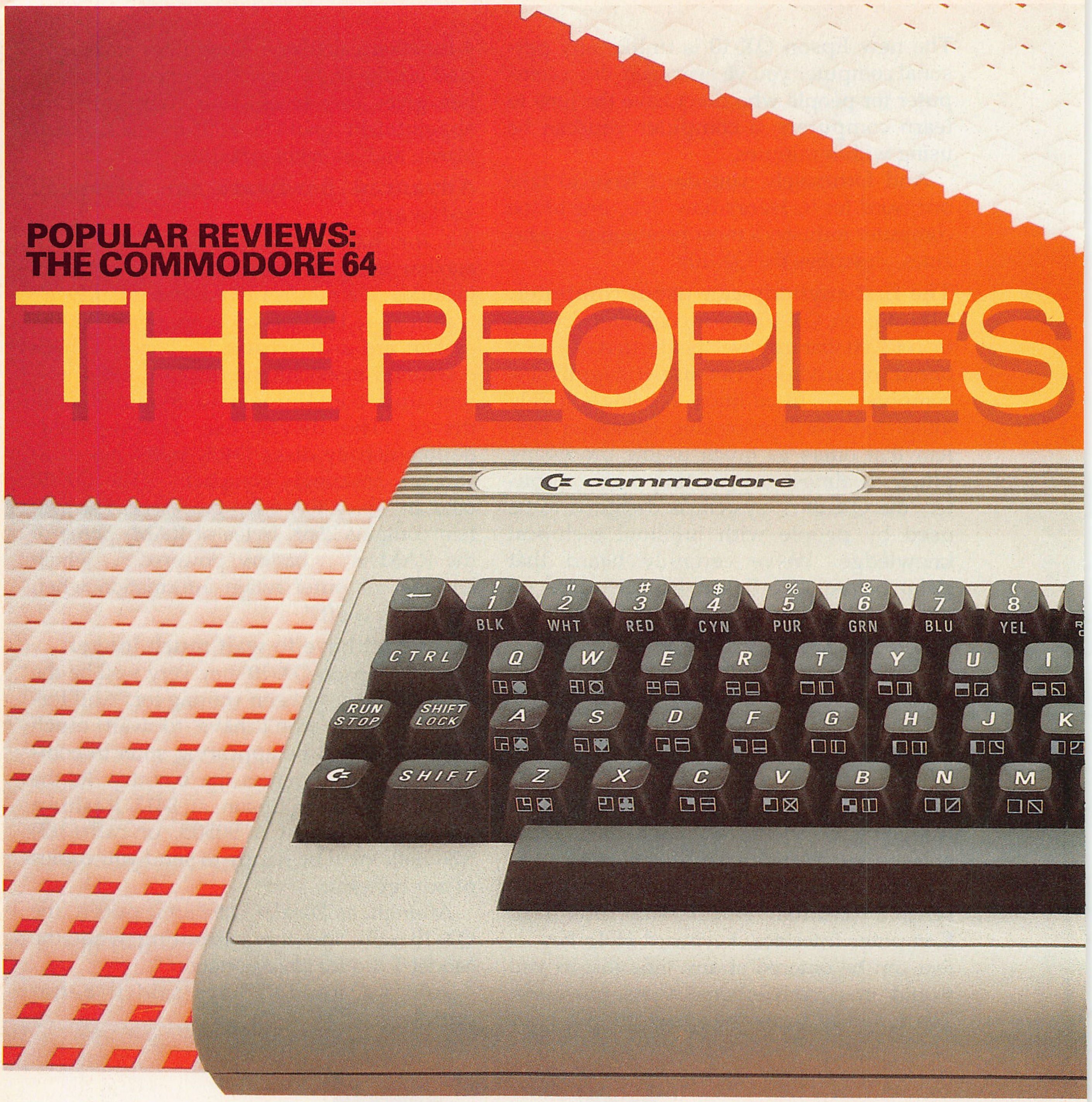
POPULAR REVIEWS: THE COMMODORE 64

THE PEOPLE'S



by Bruce Roberts

When the original Volkswagen Beetle was introduced, it offered all the features the average driver needed and set an enduring standard for inexpensive family transportation. It lived up to its name—"the people's automobile." Now the Volkswagen of personal computers has arrived! The Commodore 64 offers more bytes per buck than any of its competitors, readily earning the title of the people's computer.

The $595 Commodore 64 offers a long list of standard features and available options. It comes with 64K bytes of programmable memory (from which it gets its name), advanced graphics with 16 display colors, animation with sprites (programmable graphics characters), a three-voice music synthesizer, a 6510 (6502-compatible) microprocessor, and a supporting cast of inexpensive accessories. All of these advanced features at such an affordable price are sure to catch the eyes of millions of computer buyers (and grate on the nerves of rival computer manufacturers).

As with most new computers, the strengths of the Commodore 64 are in the hardware rather than in the available software. Commodore has announced an ex-

COMPUTER

64
CLR HOME
INST DEL
RVS OFF
RESTORE
RETURN
SHIFT
CRSR
CRSR
f 1
f 2
f 3
f 4
f 5
f 6
f 7
f 8

tensive line of software for business, school, and home use, with each program selling for less than $100, but as of this writing very little of this software has actually reached the market. Commodore has had the foresight to offer optional plug-in cartridges for both the standard CP/M operating system, which will make thousands of business programs available, and the Logo computer language, which will help the 64 make great inroads into the educational market.

The Friendly Computer Company

Commodore Business Machines is one of the few companies in the microcomputer industry that makes its own integrated-circuit (IC) chips. Because it has a ready supply of these chips, Commodore can create advanced machines sooner and at a lower cost than its competitors can. In fact, it was MOS Technology, a division of Commodore, that created the 6502 microprocessor that is so widely used in Apple II, Atari 400 and 800, PET, and VIC-20 computers.

From its humble beginnings in 1956 as a New York typewriter repair shop, Commodore has grown into a

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Bruce Roberts is a technical editor for BYTE magazine.

Photographs by Mike Blake

The integrated circuit board of the Commodore 64

1 Two 6526 complex-interface adapter chips control the connections between the 6510 central processor and the keyboard, joystick, clock, and accessories.

2 The 8K-byte BASIC read-only memory (ROM) chip

3 The 8K-byte operating system ROM chip

4 The 4K-byte character set ROM chip

5 The 6510 central processing unit (CPU), the brains of the Commodore 64

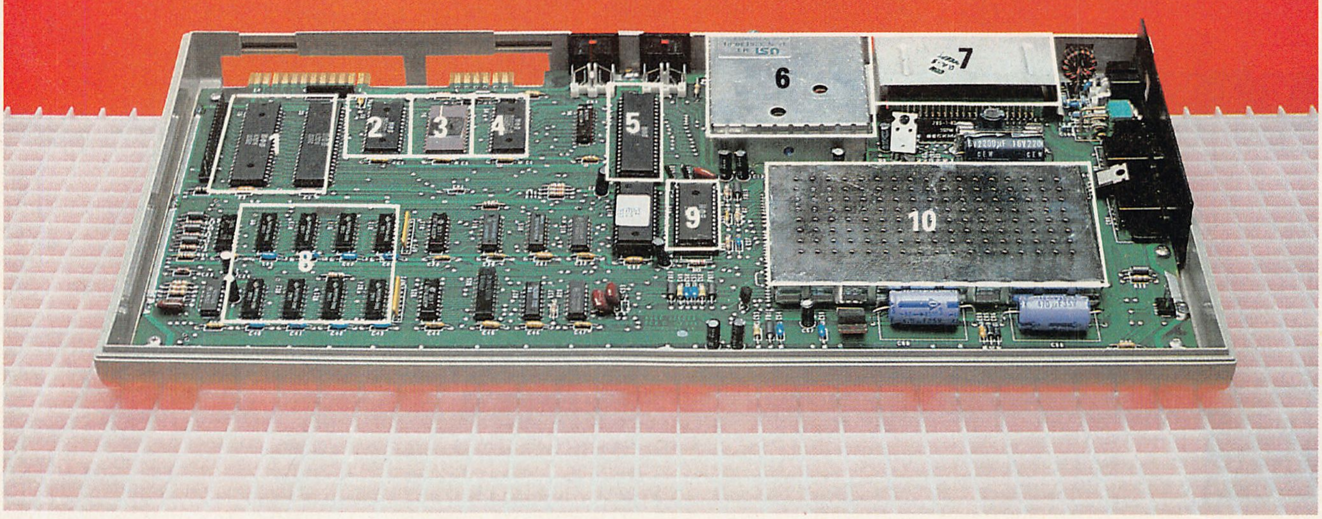
6 The radio-frequency converter translates video signals to radio-frequency signals for connection to a standard color television set via the radio-frequency output port.

7 The cartridge port for plugging in preprogrammed software cartridges

8 Eight memory chips, each holding 8K bytes of programmable random-access memory (RAM)

9 The 6581 Sound Interface Device (SID) that provides the 64 with its musical abilities

10 The radio-frequency-interference protector shields the 6567 Video Interface Chip (VIC) that provides the 64 with its graphics abilities. Several other chips are also shielded by the interference protector.



multimillion-dollar international corporation whose stock has appreciated significantly. The 64 is part of a broad selection of compatible computers ranging from the $200 VIC-20 to the new "P" and "B" series of advanced personal and business computers.

While playing upon our guilt and hounding us to buy "real computers" instead of video-game machines, Commodore has racked up enough sales of its VIC-20 computer (the predecessor to the 64) to become one of a select group of computer manufacturers able to display "over a million sold" on their golden arches. The aggressively marketed 64 is likely to achieve similar success.

The catch (and there's more than one with this computer) is Commodore's poor support for dealers and owners after the sale is made. In the past, Commodore has been slow to respond to requests for service, software, and improvements, leaving dealers and user groups to fend for themselves. Even getting replacement parts could be difficult.

Commodore is now advertising itself as "the friendly computer company," but it may take a while to overcome misgivings based on past performance. For now, the intentions are good, but the support is weak.

The Basic System

The Commodore 64 is a light, compact unit about the size of a small portable typewriter. It looks remarkably like the Commodore VIC-20 computer except for the labels and the light brown color of its case. Included with the 64 are a black power-supply box, a video cable and switch box to connect to your television set, and a 170-page user guide that looks friendly and unimposing.

This one-piece computer (revealed in the photo above) contains a 6510 microprocessor; 20K-byte read-only memory (ROM) containing the BASIC-language interpreter, Commodore's operating system, and its standard character set; 64K bytes of programmable random-access memory (RAM); and special integrated-circuit chips that give the Commodore 64 its powerful graphics and music capabilities. On the back

Radio Shack Presents The Micro Executive Workstation

- Powerful Built-In Software
- Retains Memory Data When "Off"
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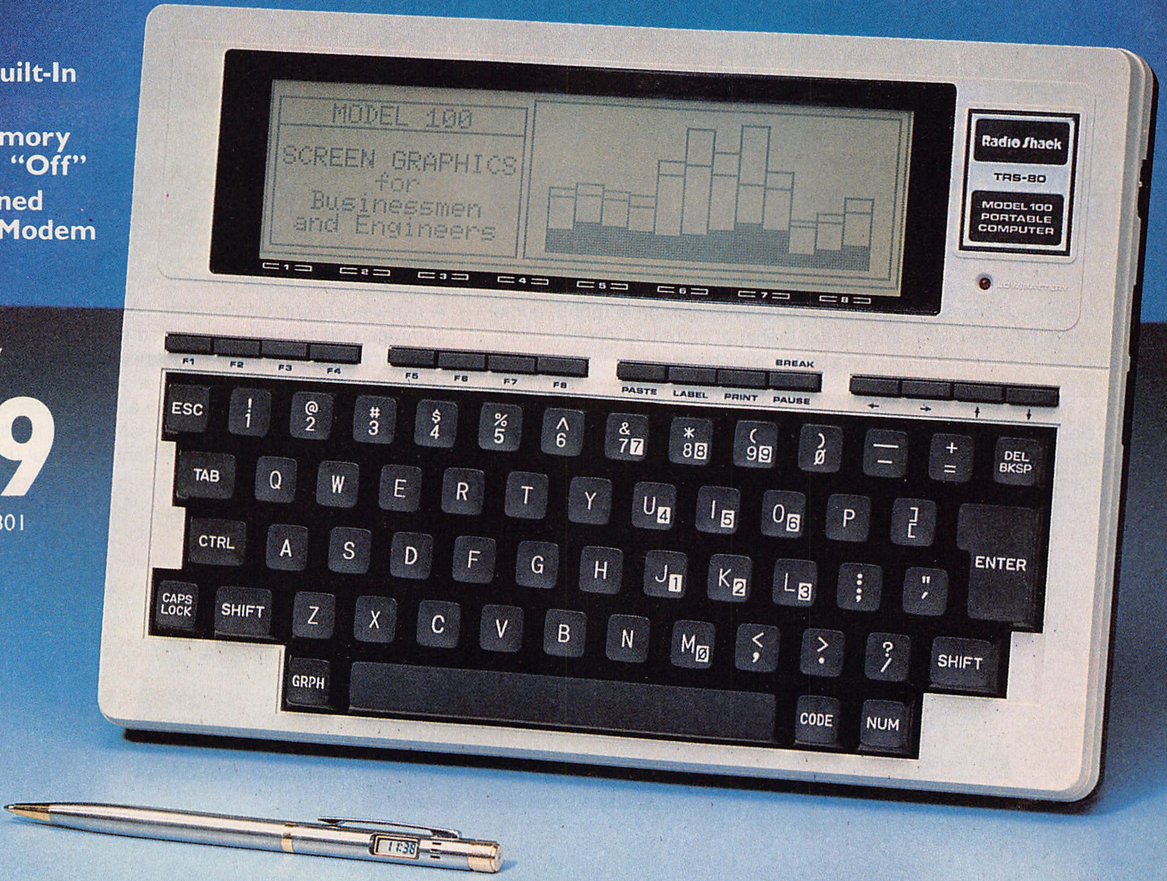
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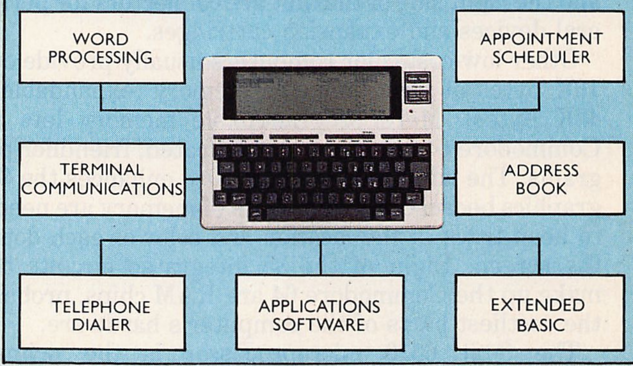
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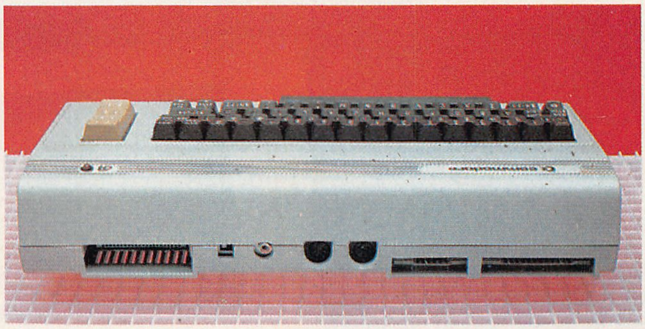
The Commodore 64 personal computer with disk drive (right), audio-cassette recorder (left), and printer (behind computer). A color television set or video monitor (not shown) is also required.



A rear view of the Commodore 64 showing (from left to right) the cartridge port for preprogrammed software cartridges, the channel-selector switch, the radio-frequency output plug for connection to a color television set, the audio/video input/output plug for connection to a video monitor or to a stereo amplifier, the serial bus port for disk drives and/or printer, the cassette port for the Datasette recorder, and the user port for standard serial (RS-232C) devices.

A close-up of the Commodore 64 keyboard with its special keys and graphics characters.

and the right side of the unit are connectors for peripheral devices and expansion cartridges.

Other low-cost color computers usually provide only 16K bytes of programmable memory (expandable to 48K bytes). More programmable memory lets the Commodore 64 run more sophisticated, friendlier programs. The additional memory also enhances the 64's graphics because large amounts of memory are needed to keep track of the location and color of each dot on the screen. Eight of the 35 integrated circuits that make up the Commodore 64 are RAM chips, probably the costliest parts of the computer's hardware.

The 8-bit 6510 microprocessor is the primary customer of all that memory, using it to store programs and data. This computer chip is internally identical to the 6502 and uses the same instructions, but it supports an additional 8-bit input/output port for memory management. This allows the microprocessor to access more than 84K bytes of memory by switching different areas (and types) of memory into the 64K bytes that the 6510 can access at any given time.

More programmable memory enables a computer to have quick access to a large work space for sophisticated, friendlier programs and enhanced graphics.

Now it's time to meet VIC and SID. The 6567 Video Interface Chip (VIC-II) is an updated version of the integrated circuit that gave the VIC-20 not only its name but also its graphics abilities and low cost. The VIC-II is a 40-column version of the old VIC chip and handles all the video-display processing, thus freeing the central microprocessor for other tasks. The 64's 40-column-by-25-line text display, 320-by-200-dot high-resolution display, and sprite graphics are all produced by this chip.

The 6581 Sound Interface Device (SID) is a three-voice electronic music synthesizer and sound-effects

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And because it's menu driven, you can choose from a wide variety of options to set your communication parameters—as well as change hardware configuration—directly from the keyboard. It even allows you to generate ASCII characters that are normally not available from Apple keyboards, further extending your capabilities. Incoming data can be printed (on serial or parallel printers) as it's displayed on your screen.

Micromodem II is available with or without the Terminal Program. Buy your modem by itself, or optionally packaged with the Terminal Program disk and user manual at extra cost. The software is also sold separately, for those who already own a Micromodem II.

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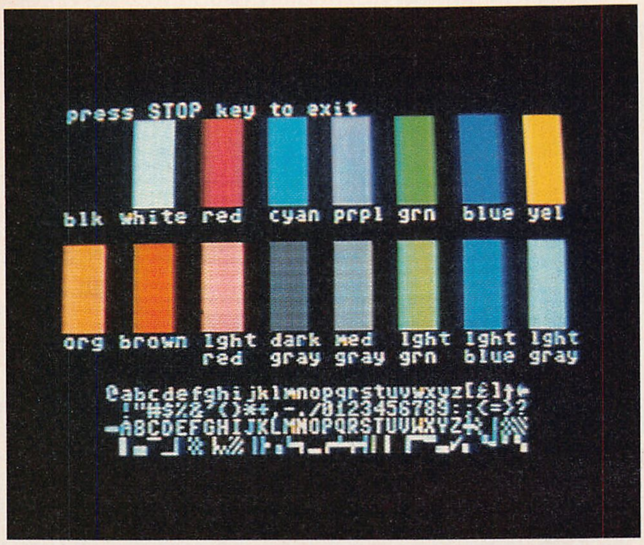
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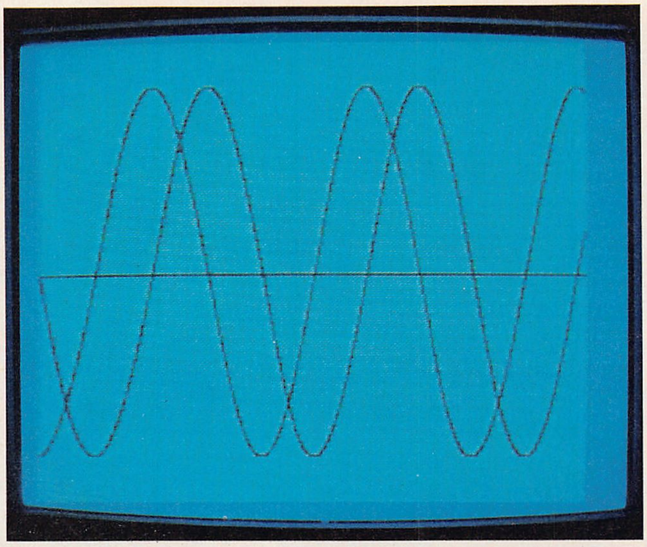
A sample of characters and colors in the character/graphics mode.



An example of the high-resolution graphics mode.

generator that provides excellent control over pitch, tone, and volume. The capacity for programmable music that this chip provides could by itself justify the purchase of a Commodore 64.

These three integrated-circuit chips are also the basis of compatibility between the 64 and other Commodore computers. Many of the game and program cartridges for the 64 may be used in other Commodore machines with no modifications. The cartridges plug into a slot on the back of the computer next to the power cord. The CP/M, BASIC-expansion, and Logo cartridges also fit into this slot. The slightly larger VIC-20 game cartridges won't work on the 64, however, because the VIC-20 doesn't use any of the above chips.

Two game-control ports on the side of the computer accept input from joysticks, paddles, or a light pen. Along the back are a connector for the television, audio and video output ports to a stereo system and video monitor, a serial port for up to five devices (four disk drives and a printer), the audio-cassette-recorder port, and a user port for accessories like the VIC-modem or standard interface connectors (see photo on page 96). You can't plug anything into the wrong socket because all of the connectors for the Commodore 64 are different.

In many ways the 64 can be thought of as a greatly enhanced repackaging of the original Commodore PET.

The Keyboard

The Commodore 64 has an excellent full-sized keyboard for an inexpensive computer. Its layout differs significantly from the standard IBM typewriter arrangement in its placement of nonalphabetic keys. Touch-typists may take a while to get used to the rearranged keys for semicolon, comma, quotation marks, and shifted characters in the top row. The lack of a tab key for word processing is especially noticeable.

The keyboard's 66 keys include four programmable special function keys that can be defined within a given program (see photo on page 96). These keys can be used with the shift key to get a total of eight special-purpose keys, a feature not offered by other low-cost computers.

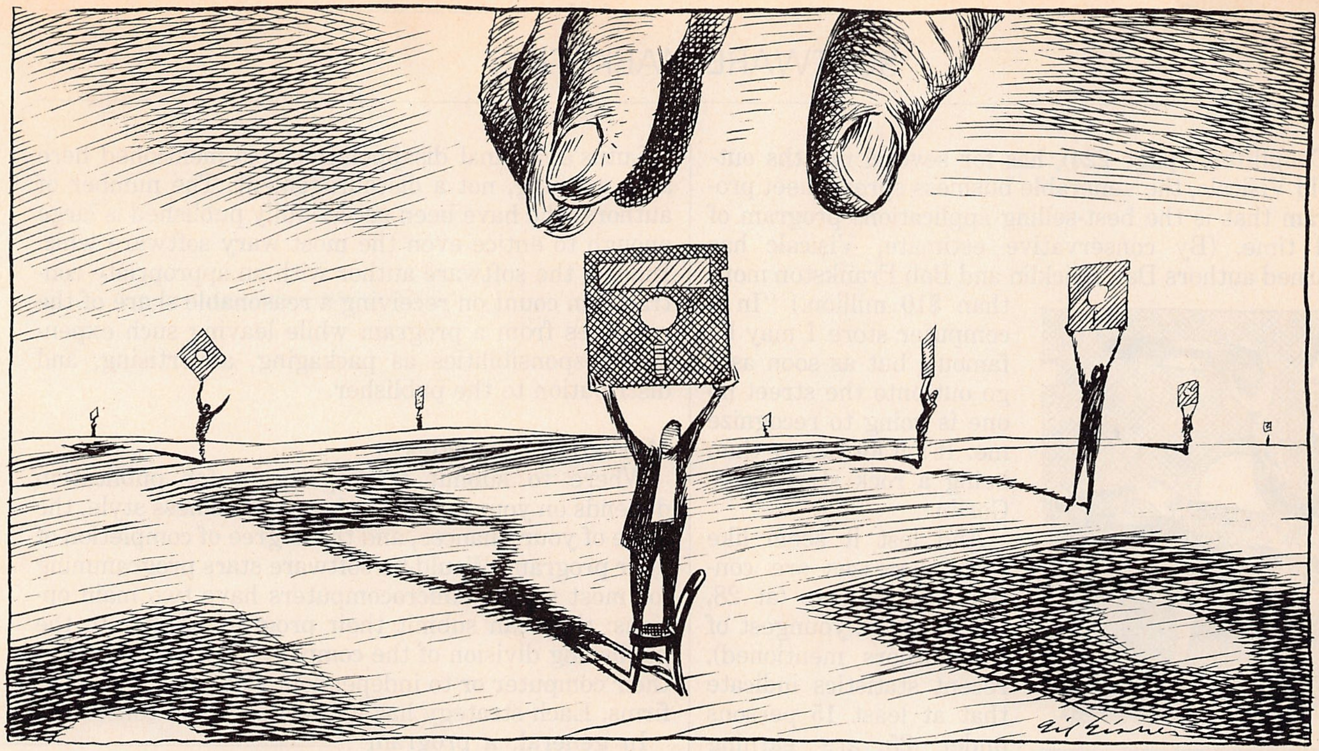
Two cursor-control keys are used with the shift key to move the cursor in all four directions. While this arrangement is workable, users of word-processing and spreadsheet programs will probably wish for four separate keys. The cursor-movement, space, and insert/delete keys automatically repeat when you hold them down, but unlike most computers, other keys will not repeat.

A type-ahead buffer helps the 64 keep up with fast typists and allows you to give a new command before the 64 has finished the last one. Because the buffer stores no more than 10 keystrokes at a time, though, an extremely quick typist might lose a character from time to time.

Mixing Text and Graphics

In many ways the Commodore 64 can be thought of as a greatly enhanced repackaging of the original Commodore PET. This shows up when you begin to use the keyboard and confront the large array of graphics characters available along with the standard uppercase and lowercase alphanumeric characters and punctuation symbols. The 66 graphics characters marked on the fronts of the keys are the same as the characters used on the original PET. While this allows

CONTINUED ON PAGE 166



Marketing Your Software

By choosing the right publisher, you too could become a software star

by Steve Ditlea

Remember the classic song "So You Want To Be a Rock 'n' Roll Star"? The Byrds, Patti Smith, and the other performers of the song over the years tried to tell us that becoming a star was a breeze. "Just buy yourself an electric guitar," they urged, "and take some time to learn how to play."

Well, that song could easily be updated to reflect how today's authors of programs for popular microcomputers can earn as much as pop music stars. Indeed, instead of learning to play a guitar and emulating Elvis Costello, you might do better learning to program a computer and following in the footsteps of Mitch Kapor, Fernando Herrera, and Dan Gorlin.

Mitch Kapor had been a disk jockey, a teacher of transcendental meditation, and an aid in a mental hospital when he decided that becoming a computer programmer might put more food on his table. He bought an Apple II "on impulse" and talked his way into a consulting job without knowing a thing about programming. He learned fast, however, and soon wrote a statistics package that became the heart of the best-selling Visitrend and Visiplot. He went $40,000 into debt to complete his program, but the gamble paid off. Visicorp paid him $500,000 in royalties before buying the program outright for another $1,200,000 in cash. Kapor earned a total of $1,700,000 for a year's work, and he is now president of Lotus Development Corporation.

Fernando Herrera was an architect designing elevators for skyscrapers when he bought an Atari 800 as an outlet for his creativity. Because his infant son's vision had been blurred since birth by cataracts in both eyes, Herrera wrote an educational program that displayed enlarged letters and bright illustrations on his TV screen. After he submitted the program to Atari's Software Acquisition Program, Atari published it as My First Alphabet and subsequently recognized his efforts with the first annual Atari Star Award and a cash prize of $25,000 (in addition to the royalties from sales of his software). "I never thought I'd be a programmer. But when I started buying software and didn't like what I saw, I began to write my own," he explains. Herrera's son, who many feared would be retarded, recently went to school for the first time. He is the only 5-year-old in his class who can read and write and operate a computer.

Dan Gorlin is probably today's most successful new software star. Choplifter, his realistic game of helicopter rescue published by Broderbund Software (see

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Steve Ditlea is the author of *The Home User's Guide to Computer Software* and a representative for software authors. He is based in New York City.

Illustrations by Gil Eisner

"Choplifter," page 224), has for several months outsold Visicalc, the venerable business spreadsheet program that is the best-selling applications program of all time. (By conservative estimate, Visicalc has earned authors Dan Bricklin and Bob Frankston more than $10 million.) "In a computer store I may be famous, but as soon as I go out onto the street no one is going to recognize me. It's a lot better than being a rock star," says Gorlin.

And lest it seem like such successes are confined to oldsters (at 28, Gorlin is the youngest of the authors mentioned), recent statistics indicate that at least 15 persons under 25 are earning more than $100,000 a year developing programs for the most popular personal computers. The obvious conclusion is that whatever your age or occupation, whether you've written a business program or an action game, you too could be a software star.

Mitch Kapor bought an Apple II on impulse and wrote the heart of Visitrend/Visiplot, earning $1,700,000 in a year.

The Perils of Paul Lutus

Unfortunately, software authors don't always find smooth sailing—even the most successful authors have tales of woe to share. Take Paul Lutus, author of Apple Writer, the best-selling word processor for Apple machines. After a stint as a NASA engineer, Lutus moved to a mountaintop in Oregon and lived without electricity for a year. When he saw the first ad for an Apple computer, he bought one, strung a 1500-foot extension cord to the nearest power line, and proceeded to create a program for his own word-processing needs. Because there were no such programs being marketed at that time, he decided to offer his word processor to Apple Computer Inc. for publication.

That's when he made his first mistake. Instead of insisting on a royalty arrangement that would have paid him a percentage of revenues totaling 10 or 20 times as much, he sold the program outright for $7500. As he says now, "I don't mind if people know about it. This may keep them from making the same mistake." Fortunately for Lutus, by the time he revised his word processor into its current Apple Writer II and Apple Writer III versions, he knew enough to ask for a royalty deal; his current contract should soon net him in excess of half a million dollars.

Lutus's original disappointment is mentioned here as a warning, not a discouragement. The number of authors who have been successfully published is large enough to entice even the most wary software whiz. Indeed, the software author with an appropriate contract can count on receiving a reasonable share of the revenues from a program while leaving such expensive responsibilities as packaging, advertising, and distribution to the publisher.

Marketing Strategies

Where to submit your program for publication depends on your programming and business style, the state of your finances, and the degree of completion of your program. Would-be software stars programming for most popular microcomputers have two main options: they can submit their programs either to the publishing division of the company that manufactures their computer or to independent software-publishing firms. Each strategy has its own pros and cons.

In general, a program published by a computer manufacturer has a better chance of making it to dealers' shelves and being sold along with a new computer simply because it bears the maker's name. Much manufacturer-published software far outsells independent publishers' offerings.

Bob Frankston and Da
over $10 million so far fo
selling application

On the other hand, because of their marketing clout, manufacturers tend to command deals with terms less advantageous to authors. Until recently, manufacturers like Radio Shack and Texas Instruments actually were biased against any software that hadn't been developed inhouse or by an established software-development firm.

Also, because they are besieged by a huge number of submissions from outside authors, manufacturers can take months to reply. Even when a program has been accepted for publication by a hardware company, the inevitable bureaucracy can significantly slow the production and distribution of your software. For example, one much-touted word-processing program recently went to an independent publisher who could have it in the stores in three months instead of the year required by a top personal computer manufacturer.

Assuming you want the fame and fortune that a manufacturer's brand name can impart to your applications program, the procedure for submitting software is similar at most companies. Write the company for guidelines (see text box on page 104 for addresses); these usually include specifications for media and documentation together with some kind of release form or contract ensuring that your program is in fact original and that the company bears no responsibility beyond reviewing your submission.

Surely every would-be software star has had nightmares about a company stealing his or her program or coming out with something exactly like it. The humbling truth, however, is that if you thought up and wrote a particular program, somebody else could have done the same. The solution to this uneasiness is to deal with reliable software outlets and to have a program that is so innovative and creative that there is no mistaking it as anything but the product of your imagination.

Bricklin have earned well

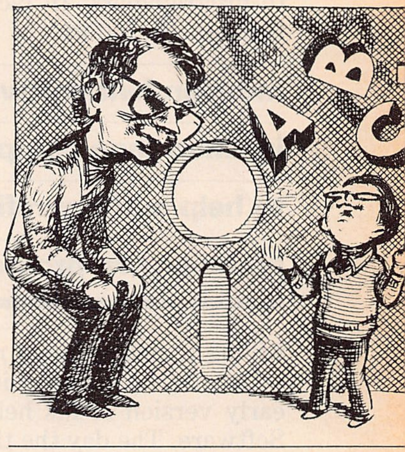
writing Visicalc, the best-

oftware of all time.

"The more original and complete the program, the better," says Bill Fischette, Apple Computer's manager in charge of acquisitions from outside programmers. Every Monday morning at 8:30, he and the members of Apple's product selection board review the past week's submissions. "Ninety-five percent of the programs are rejected because they resemble other programs or because their documentation is inadequate," reveals Fischette. "We need documentation so we can run the program.

"Sometimes we steer people to other publishers who might be more open to a particular kind of program," Fischette continues. "As a rule, we're not interested in games or in packages that duplicate any of the 160 software products we already publish. What we are looking for now are business packages for professions or businesses that would benefit from using an Apple."

Games, educational programs, and personal-finance software for Atari 400 and 800 models are the mainstay of the Atari Program Exchange (APX), the company's distribution arm for low-cost user-developed software. APX programs can sell for no more than $50, but the author's deal is perhaps the least ambiguous in the software industry. Atari gets nonexclusive rights in exchange for royalty payments based on 10 percent of the price listed in the catalog (most royalty rates today are based on wholesale prices, adjusted for special discounts to dealers, or otherwise complicated). If an APX program proves especially popular, as Fernando Herrera's did, it can be picked up for wider publication under even more advantageous terms.



Fernando Herrera wrote My First Alphabet on his Atari 800 and won a $25,000 prize.

IBM raised the ire of tomorrow's software stars when it announced a software publishing department that would accept program submissions for its new Personal Computer. Never having worked with outside software submissions before, IBM offered "nonnegotiable" terms that included a ceiling of $100,000 for an author's earnings on a program; anything above that IBM would pocket. The hue and cry from software authors and the sheer volume of submissions persuaded Big Blue to change its policy.

Now the first step in submitting a program to IBM is filling out a form that describes the program in detail and includes only the simplest of disclaimer agreements. Along with the forms that it sends out upon request, IBM includes a software submission guide that details software and documentation guidelines. Under the heading "What Types of Submissions Is IBM Interested In?" you'll find that IBM wants "quality" software and documentation that is easy to use; offers a better way to accomplish a task; entertains, challenges, or provides something special; uses the IBM Personal Computer in new, productive, and interesting ways; or improves the IBM Personal Computer's performance.

Only after the written form is evaluated will IBM consider inviting submission of the software itself. If a program is accepted for publication, the terms of the deal are then subject to negotiation. The limited number of programs IBM has released attests to the company's cautious approach to software publishing. "Our standards are high," cautions Ed Marrill, IBM's manager for applications planning. "We want unique and exciting programs. We won't help you complete a product—we won't debug it for you. We want it as close to finished as possible."

Independent Publishers

Submitting programs to independent software firms is the other main option for marketing the fruits of your programming labors. In contrast to the hardware manufacturers, these firms can be extremely friendly to programmers. In fact, firms that got their starts through the efforts of programmers are sometimes willing to help authors refine their work.

Independent software firms are more inclined than computer manufacturers to help authors refine their home-grown programs.

Dan Gorlin found this out when he submitted an early version of his helicopter game to Broderbund Software. The day the thriving software publisher received his program, Gorlin got a call offering him a trip to the company's headquarters in Northern California. Without a formal agreement, Broderbund began subsidizing his efforts back home in Los Angeles to the tune of $1000 a month for the three months it took him to revise his flight simulation program into the hostage rescue mission now marketed as Choplifter.

"The people at Broderbund had experience with features like game action and ease of play," Gorlin recalls. "They made suggestions I would never have thought of." Broderbund suggested, for example, that the tiny hostages on the screen wave after being rescued, a touch that is now one of the game's endearing features.

Broderbund's largess was quickly repaid by Choplifter's record-breaking sales. In other cases, however, the state of the art in computer games advanced so rapidly that Broderbund had to shelve programs that might have been sure sellers just six months earlier. Consequently, all publishers have become more cautious in their acquisitions. "In entertainment programs, you need to have fluidity of motion and make good use of high-resolution graphics and sound. You have to keep reaching for more programming sophistication," says Doug Carlston, a lawyer turned games author who is now president of Brøderbund.

Sierra On-Line Inc., another successful independent publisher of games and business programs, has taken author relations one step further: programmers are housed in an idyllic mountain setting near the company's headquarters in Coarsegold, California, while they finish off their masterpieces. The road to this software author's nirvana begins with the firm's hefty submissions packet, which includes testimonials from successfully published authors and from the publisher's own marketing staff. It also includes examples of advertising and packaging as well as a sample contract and a nondisclosure agreement to protect the author.

According to Ken Williams, Sierra On-Line's chairman and programming ace, "Your primary concerns when selecting a publisher should be items such as distribution channels, marketing capabilities, and support both for yourself and to customers." Like a number of other independent software publishers, Williams's firm claims to pay "the highest and most regular royalties in the business."

Publisher of the best-selling Wizardry, Robert Sirotek proclaims in ads headlined "Authors Wanted" that his firm, Sir-tech Software, can offer the "best royalties in the business." If pressed, he admits that most major publishers pay similar royalties that range "between 10 and 30 percent of the publisher's revenues. Games tend to get the lower royalties, in the 10 to 20 percent range, but I've made deals all over the board depending on the quality of the software submitted."

If most publishers make similar deals, why choose one over another? It all depends on your program. Should Pascal be your forte, Sir-tech might well be the best place to seek publication because of the publisher's experience with the Pascal-based Wizardry. If you've come up with a nifty arcade game for the TRS-80 Model III, Adventure International might be the ideal choice. A CP/M-based business program brings to mind Lifeboat Associates, the largest vendor of such software.

Choosing an appropriate publisher can be as important to the software star of the future as writing an excellent program. Which publisher's programming style most resembles your own? Whose advertising or packaging do you find most effective? Whose programs do you most often see on dealers' shelves? Keeping up with the software industry will save you the effort of submitting a great program to the wrong publisher and could even determine whether your program makes a bundle for you. "Look for strong technical competence and marketing ability in a software publisher, or the computer program you hope to sell may never get off its floppy disk," advises Fred Pood, marketing vice-president at Micropro International, publisher of the word-processing champ Wordstar.

Negotiating Contracts

So the publisher of your choice likes your program and wants you to sign a publishing deal—what now? Even if you've never negotiated anything more complicated than a U-turn, you are about to become involved in the process of negotiating a contract. Chances are the publisher will offer you a "standard" contract with a "standard" royalty deal and urge you to settle on such reasonable terms, but in most cases you will be able to get a more suitable deal if you know what to ask for.

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at your meetings or contacts with a publisher, but you should consult beforehand with a lawyer knowledgeable in the area of software contracts. According to Susan Nycom of the firm Gaston, Snow, and Ely Bartlett in Palo Alto, the burgeoning field of computer law has already generated its own legalisms. "Though the fundamental points may be similar to a book-publishing deal or any other kind of contract," she explains, "the specific language and structure of a software contract can be quite different." She estimates that over 100 attorneys around the country have expertise in computer law. "To find a lawyer near you, you might try phoning the Computer Law Association in Washington, D.C., the Association for Computing Machinery in New York City, or your local bar association," Nycom advises.

When all is said and done, however, the deal you end up with will depend on the desirability of your program. "As usual, everything depends on the author's leverage," says Nycom. "The terms increase in proportion to how much the publisher wants an author's program." The complexity of negotiations between author and publisher will also be a reflection of a program's clout. "Sometimes a handshake is enough," comments Boston attorney Robert Bigelow, "but sometimes you negotiate until you're blue in the face and it still doesn't work out."

Whatever the agreement with a publisher, it will essentially cover the assignment of certain rights to a program. You might be signed for nonexclusive rights, allowing you to continue selling your program through other channels, or you might strike a machine-specific deal, which permits you to sell to another publisher versions of your program for other computers. The purchase of exclusive rights establishes an incentive for the publisher to advertise and promote a program; it should also mean more lucrative contract terms. In any contract, it is important to agree to a reasonable duration. Some software publishers are insisting on irrevocable rights, which means the publisher has never-ending rights to your program. More realistic contracts run for a fixed period of time with a simple procedure for renewal or termination.

How much can you expect to make in exchange for the rights to your program? Very little at first. Advance payments against royalties are still rare in the software industry for anything but the sensational program. If you need an additional disk drive or some utilities software to complete a program, that may constitute your sole advance on royalties.

The money doesn't start flowing until your program is actually being sold to dealers. The wait will have been worth it, though, when you finally do receive that first royalty check. Whether it's for a few dollars or tens of thousands, it represents the personal computer community's recognition of your talents.

Your program on the dealers' shelves? Your software on the best-seller lists? The rewards should be ample for the authors of tomorrow's software hits. With good ideas and hard work you too could become a software star. Just buy yourself a personal computer and take some time to learn how to program. □

Where to Get Your Software Published

For further information on software submission policies, write to the following companies:

Adventure International
POB 3435
Longwood, FL 32750

Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014

Atari Software Acquisition Program
3281 Scott Blvd.
Santa Clara, CA 95055

Broderbund Software
1938 Fourth St.
San Rafael, CA 94901

IBM Corporation
External Submissions Dept. 765 PC
Old Orchard Rd.
Armonk, NY 10504

Lifeboat Associates
1651 Third Ave.
New York, NY 10028

Micropro International Corp.
33 San Pablo Ave.
San Rafael, CA 94903

Sierra On-Line Inc.
Sierra On-Line Building
Coarsegold, CA 93614

Sir-tech Software Inc.
6 Main St.
Ogdensburg, NY 13669

Tandy Corp./Radio Shack
1800 One Tandy Center
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Texas Instruments
POB 10508
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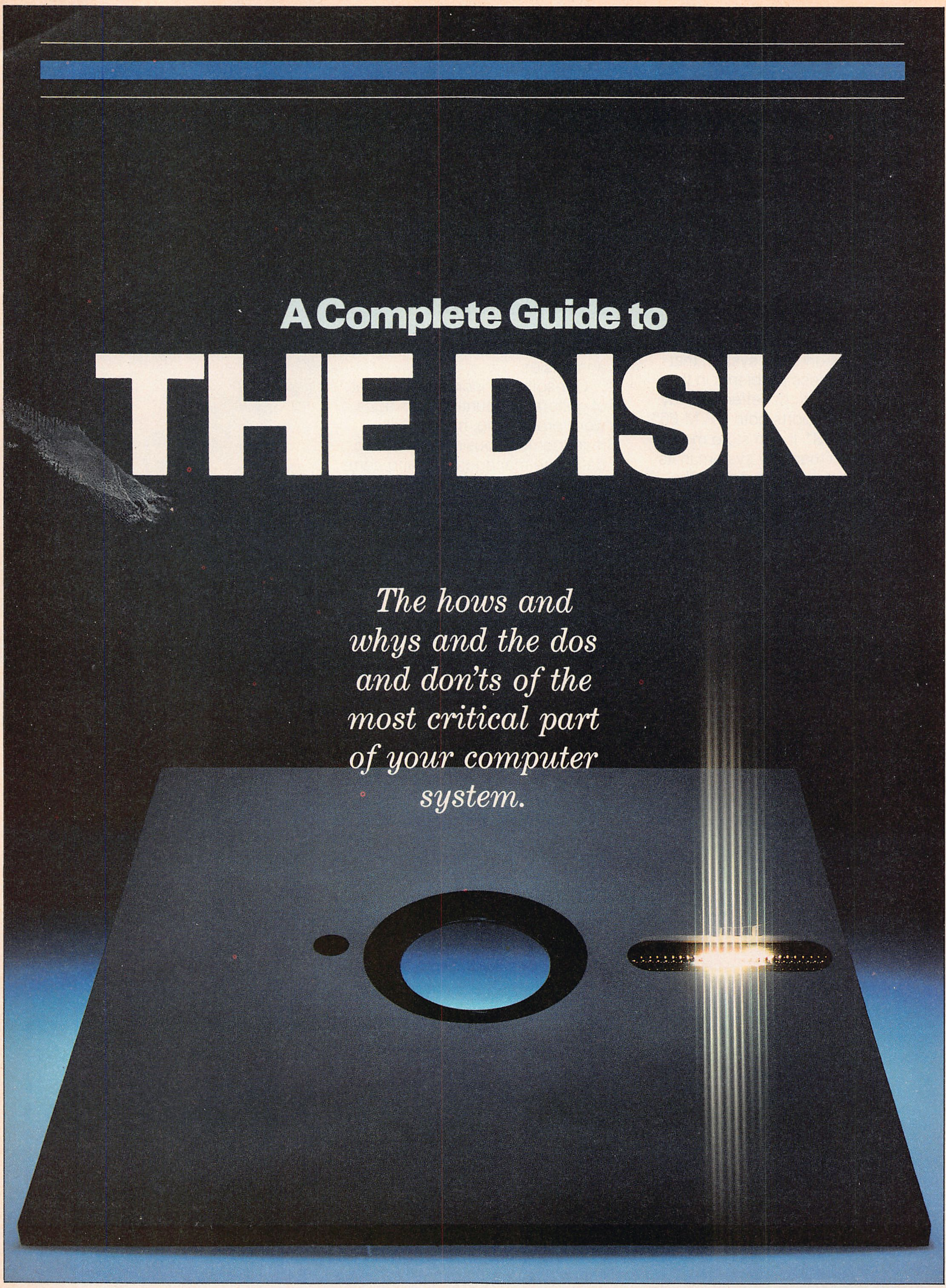


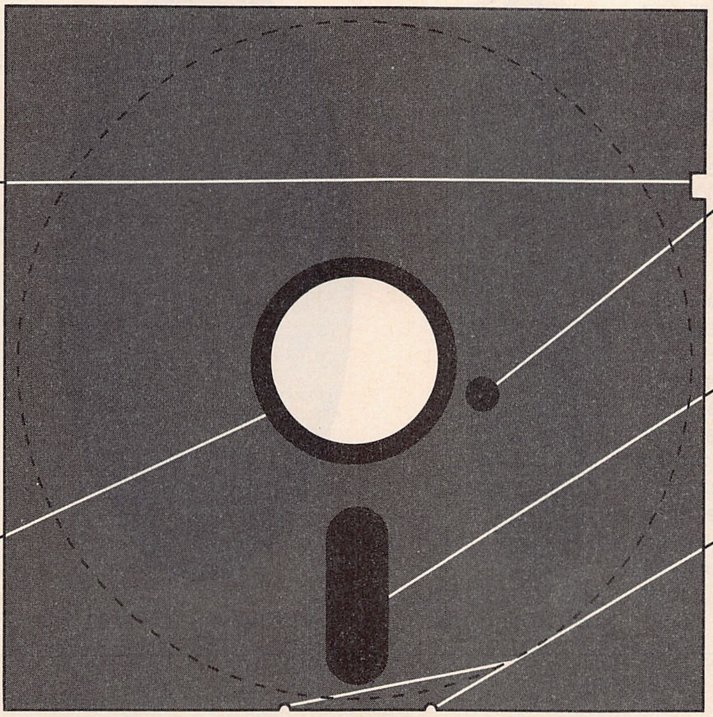
A Complete Guide to

THE DISK

The hows and
whys and the dos
and don'ts of the
most critical part
of your computer
system.

Photograph by Paul Avis

The Disk in Its Protective Cover



The write-protect notch in the upper right-hand corner of a disk protects the information on a disk from accidental erasure or overwriting. When the notch on a disk is open, information can be written on the disk or erased from it. When the notch is covered by one of the tabs that comes with every blank disk, the disk is said to be write-protected. Any attempt to write information on the disk or erase the disk will result in an error message. Information already on the disk, however, can be read without interference.

The centering hole is used to rotate the disk. The disk-drive spindle fits tightly in the hole, allowing the disk to rotate at 300 revolutions per minute (rpm).

The index-hole window is a small round opening near the centering hole. As the disk rotates, a beam of light passes through each index hole in the disk itself, whenever an index hole lines up with the window.

The head access window exposes the magnetic surface of the disk to the read/write head of the disk drive. The head mechanism moves forward and back along this opening to read and write data on the disk.

The alignment notches at the bottom of the disk cover are used to ensure that the disk is placed correctly inside the disk-drive mechanism.

by Carlene Char

Few parts of a computer system generate less curiosity than a floppy disk. How excited can you get about a flat black card that just sits there when you look at it? It doesn't even light up. Pretty boring, right?

Don't be so sure. A disk is possibly the most vital and most sensitive part of your computer system. Treat it right and it will be your trusted ally for storing the programs and information you've worked so hard to create. Abuse it and it may develop amnesia, garble your data, and even destroy your disk drive. Indeed, learning something about the workings and care of a floppy disk today may spare you a lot of grief tomorrow.

This article will focus on the 5¼-inch floppy disk that is most commonly used with personal computers. (See "Future Computers" on page 136 for more about microfloppy disks and other new trends in disk storage.) First we'll take a look at the anatomy of a disk and how information is stored on it, and then we'll examine some tips on getting the most from your disk and avoiding those memory-shattering experiences. The glossary on pages 110–111 should help you find your way through a thicket of disk-related terms.

Anatomy of a Floppy Disk

Have you ever looked at a 5¼-inch floppy disk carefully? When you remove it from its envelope, the first thing you notice is that it appears to be a flat square. Of course, what you see is not actually the disk but a square vinyl jacket that protects the disk from dust, grime, and fingerprints. Inside the jacket is the disk itself—a thin, round, saucer-like object, slightly over 5 inches in diameter, made of Mylar plastic and coated on both sides with a thin layer of metallic oxide. If you hold the disk so that the manufacturer's label is in the upper left-hand corner, you'll see a rectangular *write-protect notch* on the right side and two tiny *alignment notches* on the bottom. The jacket itself has three holes: a large *spindle hole* in the center, a small *index-hole window* just to the right of the center, and an oblong *read/write access window* about an inch long near the bottom. This window exposes the part of the

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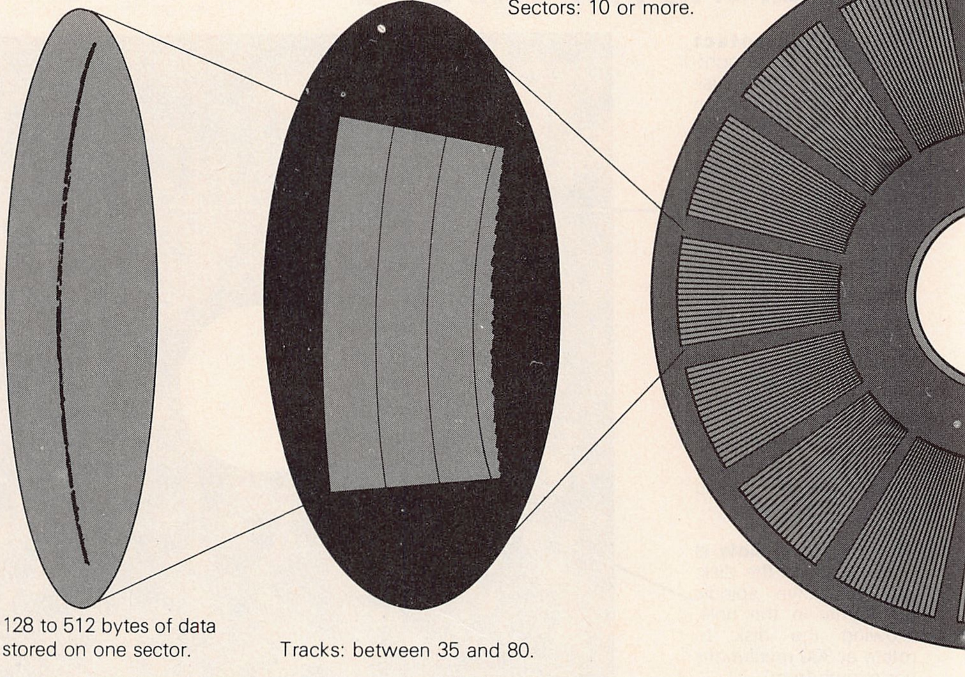
Carlene Char is a freelance writer who lives in Honolulu, Hawaii.

How Data Is Stored on a Disk

Data is stored on the disk's surface on a ring that is less than one inch wide. As the disk rotates at a rate of five revolutions per second, the disk-drive head emits a stream of magnetic data pulses that create a series of tiny magnetic fields along a circular track on the disk's surface. At a rate of 125,000 data pulses per second, a single-density disk head can store up to 25,000 individual bits of data on a disk during a single rotation. Each circular track is divided into between 10 and 16 sectors that store up to 512 bytes of data each. (Every byte contains 8 individual data bits.) When one disk rotation is complete, the disk-drive head moves forward to the next track and starts emitting pulses again. The most sophisticated disk heads in use today can support a track density of 96 tracks per inch, allowing a total of 80 tracks per disk.



Sectors: 10 or more.

128 to 512 bytes of data stored on one sector.

Tracks: between 35 and 80.

disk on which data is recorded (see "The Disk in Its Protective Cover," page 107).

Now let's examine the disk itself. You'll notice that the center hole of the disk is strengthened with a *hub-protection ring* (almost all disks have one now, although it may be missing from disks made a few years ago). If you put two fingers into the center hole and press outward gently, you can rotate the disk until a small *index hole* appears in the index-hole window. The index hole enables the computer to keep track of the disk's position as it rotates (see "The Disk Exposed," page 109).

A ring of magnetic oxide runs around the outer part of the disk's surface. It is important to protect this part of the disk from dust and prying fingers.

Without touching the disk surface, look through the oblong access window. You can see the ring of magnetic oxide about one inch wide that runs around the outer part of the disk's surface. It is important to protect this part of the disk, where information is actually stored, from dust and prying fingers. The back side of a disk contains a similar magnetic ring, which can be used to store data as well.

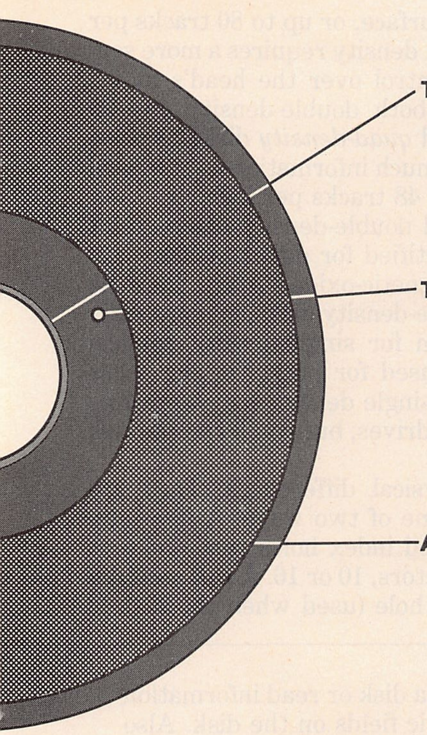
How Information Is Stored

How is data actually stored on a disk? Let's examine the process using that very sentence as an example. The sentence is made up of 38 characters, including spaces and the question mark at the end. Each character is represented by a number according to the *ASCII code* (American National Standard Code for Information Interchange). Each of the ASCII code numbers is in turn stored as an 8-bit binary number in the computer's memory.

Look at the first word in the sentence, "How." The ASCII code for the uppercase letter "H" is 72, which is stored in the computer as the binary number 01001000. The ASCII code for "o" is 111, stored as the binary 01101111; for "w" it is 119, stored as binary 01110111; and for the blank space at the end of the word it is 32, stored as binary 00100000. In this way the computer translates each word of our sentence into a string of 304 individual *bits* of information (38 characters, or *bytes*, times 8 bits of binary information for each byte). "How is data actually stored on a disk?" is then stored on the disk as a series of 304 tiny magnetic fields.

A magnetic field has a polarity, or direction, from right to left or from left to right. One of these directions represents a 1, the opposite, a 0. Creating magnetic fields on a disk is the job of the *read/write head,* the movable part of the disk drive. When you tell the computer to store information on the disk, the head moves forward to a position determined by the

The Disk Exposed



The hub-protection ring in the center of the disk keeps it from being mangled by the disk-drive spindle during its many thousands of rotations. Most disks now include hub-protection rings, although you can purchase a hub-ring kit to add protection to a disk that comes without one.

The single index hole in a soft-sectored disk lets the computer know where the disk is as it rotates. A beam of light is aimed through the index-hole window on the disk cover. When the hole itself is aligned with the window, the light shines through the index hole, triggering a light-sensitive switch that tells the computer one disk revolution has been completed. A hard-sectored disk has an index hole for each sector and one more for alignment.

A one-inch ring of the disk's surface is coated with a thin magnetic flux that is used to store data. The *read/write head* of the disk drive actually reads the direction of the magnetic field at each point on the disk. The amount of information that can be stored on a disk depends on the number of individual magnetic fields that can be squeezed onto the disk's surface and on the speed, sensitivity, and accuracy of the disk-drive head itself.

disk operating system (DOS), which is simply the software that controls the storage of data on disks. As the disk rotates (at a rate of 5 revolutions per second), the head creates a sequence of 304 individual magnetic fields, each corresponding to either a 1 or a 0 as it stores our leading question.

It sounds like a tedious process, but a standard single-density disk-drive head sends an electronic impulse, or *data pulse,* creating a new magnetic field, every 8 microseconds (125,000 pulses per second). Thus all 304 magnetic fields needed to store the question "How is data actually stored on a disk?" are stored within 2432 microseconds, a little more than 2-thousandths of a second. Because a disk revolution takes one-fifth (200-thousandths) of a second, more than 80 sentences like our example could be stored during a single disk rotation.

Actually, the amount of data stored on a given disk depends on how that disk is *formatted* by a particular disk operating system into *tracks* and *sectors.* Data is stored along a series of between 35 and 80 concentric tracks that are divided into 10 or more sectors. (See "How Data Is Stored on a Disk," page 108, for a more detailed description.)

The amount of data stored on a 5¼-inch disk can vary greatly from one disk drive and disk operating system to another. At the low end of the storage spectrum are the *single-density* disk drives. For example, the Osborne 1 stores data on 40 tracks, each of which has 10 sectors that store 256 bytes of data each, a total capacity of 100K bytes (102,400 bytes to be exact) of data storage per disk. But because some of the disk is used to store formatting information and the disk operating system software, the actual amount of user data-storage space available is quite a bit less than that. The Apple II is also at the low end of the spectrum. The Apple's disk operating system, DOS 3.3, formats each disk into 35 tracks of 16 sectors each, for a total storage capacity of 140K bytes.

At the other end of the spectrum, some *double-density* disk drives can pack more than 500K bytes (a half a *megabyte*) of information into a disk because they have 80 tracks instead of the standard 40, 16 sectors per track, and 512 bytes per sector. Disk drives with double-sided heads—one head on each side of the disk—can store twice as much information on a 5¼-inch disk.

The amount of data that can be compressed onto a single disk depends on the density of data in each track and the number of tracks per inch.

The *density* of information storage, or the number of bits that can be stored along any one track on the disk's surface, is determined by the data pulse rate of the disk-drive head. Single-density heads send or receive one *pulse* of data every 8 microseconds. Double-density heads send or receive data every 4 microseconds. A single-density disk drive must be used with a single-density disk, but the pulse rate of a double-density drive can be slowed down so that it can work with either single- or double-density disks.

Disks certified for single density may work fine with double-density disk drives, but you may lose data.

Another factor affecting the amount of storage on a disk is *track density*, the number of tracks per inch. The least sophisticated disks store data on up to 40 concentric circular tracks. Forty-eight tracks per inch are squeezed onto the magnetic part of the disk surface. More recent technology can squeeze 96 tracks per inch onto the same surface, or up to 80 tracks per disk. This increased track density requires a more sensitive head and finer control over the head's movement. Disks that have both double-density and 96 tracks per inch are called *quad-density* disks because they store four times as much information as standard single-density disks with 48 tracks per inch.

In practice, single- and double-density disks aren't very different. Disks certified for double-density use have a higher-quality magnetic-oxide surface. Because they cost more than single-density disks, you probably won't want to buy them for single-density applications, but they can be used for both. On the other hand, disks certified for single density may work fine with double-density disk drives, but you'll run the risk of losing some data.

Disks have other physical differences. They are divided into sectors in one of two ways. A *hard-sectored* disk has prepunched index holes that divide it into a fixed number of sectors, 10 or 16. A *soft-sectored* disk has only one index hole (used when the disk is

Disk-Related Terms

alignment notches—two small semicircular notches in the disk jacket that ensure that it is properly inserted in the disk drive.
ASCII code—the American National Standard Code for Information Interchange. The code by which characters are translated into numbers in a computer's memory. Each ASCII code number uses 1 byte of computer memory.
bit—a single digit of information, 0 or 1, as used by a computer.
byte—an 8-bit sequence of binary digits. Each byte corresponds to one character of data, representing a single letter, number, or symbol. Bytes are the most common unit for measuring computer and disk storage capacity. See *kilobyte, megabyte.*
data pulse—an electronic signal sent by the disk-drive head to create a tiny magnetic field on a disk.
density—the amount of data that can be stored on one sector of one track of a floppy disk. The density is determined by the rate at which the disk-drive head emits data pulses. A faster rate results in a higher density of bytes stored per sector. See *single-density disk* and *double-density disk.*
disk—see *floppy disk.*
disk drive—an electromechanical device into which a disk is inserted to read or write information.
disk-drive controller—a hardware interface, between the disk drive and the computer, that controls the operation of the disk drive.
disk-drive head—an electromagnetic device that sends and receives data pulses that allow it to create magnetic fields on a disk or read information already stored in magnetic fields on the disk. Also called the *read/write head.*
disk operating system (DOS)—software that controls the process of transmitting information to and from a disk. The disk operating system formats the disk and keeps track of where information is stored on it.
double-density disk—a disk on which twice as much information can be stored through use of a disk-drive head that emits a data pulse every 4 microseconds—twice as fast as that of a single-density disk.
double-sided disk—a disk that can store information on both sides.
floppy disk—a flexible disk, made of Mylar and coated with a magnetic oxide, used for storing and retrieving computer data. Sometimes called a *floppy diskette.*
format—the arrangement by which information is stored on a floppy disk in tracks and sectors.
formatting—the process by which the disk operating system organizes a floppy disk into tracks and sectors for storing data.
hard-sectored disk—a disk that is divided into a fixed number of sectors, usually 10 or 16. A hard-sectored disk has one index hole for each sector and one additional hole for disk alignment. See *soft-sectored disk.*
head—see *disk-drive head.*
head access window—an oblong slot in the disk jacket that allows the disk-drive head access to the information stored magnetically on the disk.
hub-protection ring—a plastic ring that

originally formatted) and is formatted into sectors by the disk operating system software. Moreover, a soft-sectored disk can be formatted for use with many different operating systems. The flexibility of soft-sectored disks has made them the type most people prefer. On the other hand, the process of formatting information uses up some of the storage space on a soft-sectored disk, so a soft-sectored disk generally stores less data than a hard-sectored disk.

Flipping the Floppy

Double-sided disks and their corresponding disk drives take advantage of the fact that both sides of a floppy disk are coated with a magnetic-oxide layer. By having two heads—one on each side of the disk—a disk drive can read or store twice as much information on a single disk. Actually, a double-sided disk can also be used with a single-head disk drive if you flip the disk over and reinsert it.

Single-sided disks can be used on both sides for some purposes. All you have to do is cut a write-protect notch in the opposite side of the disk jacket and carefully punch a set of index holes opposite the original index holes in the jacket (see "Flipping the Floppy" on page 112).

A double-sided disk can be used with a single-head disk drive if you flip the disk over and reinsert it.

You may be able to purchase a "flippy kit" from a dealer or by mail order to help you accomplish this. Be warned, though: it's not necessarily a good idea to use both sides of such a disk too frequently. It may not even save you any money in the long run. If you store data on both sides of a disk and use it twice as often, the disk may just wear out twice as fast. Furthermore, a flipped disk rotates in both directions. Dust and grime that are normally retained in the jacket can be

strengthens a disk's center spindle hole. Hub protection rings are now built into most floppy disks to prolong disk life.

index hole—a small hole in the disk surface, near the center hole. As the disk rotates, a light shines through the index-hole window in the disk jacket and triggers a light-sensing device whenever an index hole passes the window. This is used by the disk operating system when formatting the disk. A hard-sectored disk has an index hole for each sector.

index-hole window—an opening in both sides of a disk jacket that allows a light beam to pass through an index hole every time it rotates past the window.

kilobyte (K)—informally, 1000 bytes of information. Actually, 1K bytes consist of 1024 bytes of information. (All totals given in K bytes should be multiplied by 1024 to get the exact number of bytes stored.) Disk storage is usually rated in terms of K bytes of information. See *byte, megabyte*.

magnetic oxide—an iron-oxide layer on the surface of a floppy disk that is used to store data in a series of tiny magnetic fields.

megabyte (M)—1 million bytes of information.

microfloppy disk—a 3-inch to 3½-inch floppy disk enclosed in a plastic cartridge. This size is called *microfloppy* to distinguish it from 5¼-inch *minifloppy disks*.

minifloppy disk—a 5¼-inch floppy disk. This size is often called minifloppy to distinguish it from 8-inch floppy disks.

quad-density disk—a double-density disk with twice the track density of a standard disk. A quad-density disk stores four times as much information as a regular single-density disk. See *density, double-density disk, single-density disk,* and *track density.*

sector—the fraction of a circular disk track on which data is stored. The number of sectors of a soft-sectored disk is determined when it is formatted by a disk operating system. Typical values are between 10 and 16. The number of sectors of a hard-sectored disk is predetermined by the number of index holes in the disk, usually 10 or 16.

single-density disk—a disk that stores between 128 and 256 bytes per second. A single-density disk-drive head emits a data pulse every 8 microseconds as the disk rotates.

single-sided disk—a disk intended for use on only one side.

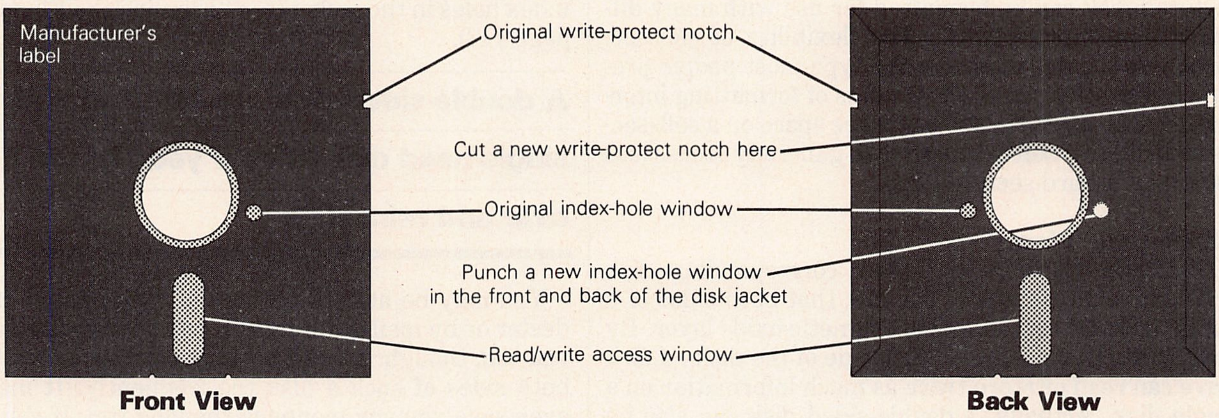
soft-sectored disk—a disk with only one index hole, for which the number of sectors is determined when the disk is formatted by a disk operating system. See *hard-sectored disk.*

track—a circular strip on a disk's surface on which data is stored.

track-density—the number of circular tracks per inch on the surface of a disk. A standard track density is 48 tracks per inch. Some newer disks have double that amount, 96 tracks per inch.

write-protect notch—a rectangular notch on the side of a disk jacket that prevents any change in the information already stored on a disk. For a 5¼-inch floppy disk, covering the notch with a small tab protects the disk. For an 8-inch floppy disk, the reverse is true: opening the notch protects the disk, while covering it allows information to be written on or erased from the disk.

Flipping the Floppy


Manufacturer's label
Original write-protect notch
Cut a new write-protect notch here
Original index-hole window
Punch a new index-hole window in the front and back of the disk jacket
Read/write access window
Front View
Back View

You can use a single-sided disk on both sides by cutting a symmetrical write-protect notch and punching new index-hole windows in the top and bottom of the disk jacket. Be careful not to damage the disk in any way as you do this. A rough-edged hole punch may leave jacket fibers that could shorten the life of your disk considerably. A disk made in this way should be used only for archival or back-up purposes. The durability of your data is not assured if the disk gets a lot of use.

released by bidirectional spinning, further shortening the life of your disk. A good rule of thumb is to use both sides of a disk that's primarily for archival or back-up purposes and to use single-sided disks for everyday purposes.

Disk quality is often rated in terms of the number of million rotations the disk can survive. But chances are a user won't live long enough to use millions of rotations.

Certified Disks

Approximately 45 million floppy disks (both 5¼-inch and 8-inch) were sold in 1979, and an estimated 230 million will be sold annually by 1984. Given these astronomical figures, you'd expect the quality of disks to vary widely. But most disks sold can be expected to meet or exceed established performance levels, thanks to industry standards set by the American National Standards Institute (ANSI).

Requirements for disk certification fall into four categories: their ability to withstand environmental conditions, their physical quality, abrasivity, and signal performance. In the first place, a disk should hold up under temperatures from 50° to 125°F and relative humidities from 8 to 80 percent without warping. For disks being transported, the tolerances are even greater: −40° to 125°F and 8 to 90 percent humidity.

Testing physical requirements is a nit-picker's holiday. Every dimension of the disk, including distance between tracks—indiscernible to the naked eye—is measured to a thousandth of a millimeter. Other important physical tests include light transmittance, starting and running torque, and expansion due to heat and humidity. An overly abrasive disk causes excessive wear of the disk-drive head. Disk abrasivity is measured by recording signal amplitudes taken before and after a test run.

Ultimately a disk's worth is measured by its signal performance. A disk can't be certified by ANSI if it's deficient in signal quality. One type of error is the dropout, or missing bit, caused by a "hole" in the disk's magnetic coating. Another type of error is the dropin, or extra bit. A certified disk is error-free.

Life and Death Issues

How long should you expect a disk to last? The minimum warranty for a certified disk is one year. Some disks carry warranties extending beyond five years, and lifetime warranties are not uncommon, but you probably don't need a disk with a lifetime warranty. If you read the fine print you'll see that warranties are honored only if a product defect is involved. Because most disks die from "natural" causes—coffee showers, dust storms, heat stroke, fallen ashes, and normal wear— a failed disk can rarely be replaced, even if it's covered by a warranty.

When should a disk be discarded? Most obviously, when it develops problems in reading or writing data or if it consistently gives you "track errors" when you're formatting it. To avoid lost data and its accompanying frustration, replace heavily used disks at regular intervals. The cost of replacing disks every three to six months is minimal compared to the cost of computer downtime and lost data.

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The $1795 suggested retail price for the Osborne 1 (a registered trademark of Osborne Computer Corporation) includes a full business keyboard, built-in CRT display, two built-in floppy disk drives, CPU and 64 kilobytes of RAM memory, RS-232 and IEEE 488 interfaces, and the following software packages: WORDSTAR® word processing with MAILMERGE® (a trademark and a registered trademark of MicroPro International Corporation of San Rafael, California); SUPERCALC® electronic spreadsheet system (a trademark of Sorcim Corporation); CBASIC® (a registered trademark of Compiler Systems); MBASIC® (a registered trademark of Microsoft); and CP/M® (a registered trademark of Digital Research).

Circle 80 on inquiry card.

Manufacturers like to describe the quality of their disks in terms of survival tests: "Brand X survives N million passes without disk-related errors." Maxell, a respected manufacturer, boasts 10 million passes on its floppy disks. Verbatim's newly introduced Optima disks are rated at an incredible 70 million passes.

Wabash disks are rated at a "paltry" 3 million passes. But as Alan Whitebread, Marketing Manager for Wabash Diskettes, points out, "A user will not live long enough to use 3 million passes on a 5¼-inch disk under normal-use conditions, even if those conditions apply 24 hours a day."

If a spinning floppy sounds like coarse sandpaper, it probably is. You won't want it coming into daily contact with your disk-drive head.

Think about it. A 5¼-inch disk rotates at 300 rpm, or 18,000 passes per hour. The disk completes 3 million passes in 167 hours. Granted, 167 hours doesn't sound like a very long time. But consider that the average disk drive isn't spinning constantly. Once disk memory has been accessed, most drives stop rotating. As a result, 167 hours of disk use may stretch over months or even years. And if you're like me, more than half of your disks are probably sitting quietly on a dust-free shelf most of the time.

For most of us, any ANSI-certified disk will do. Shop around for the best buy. The list prices for a box of ten 5¼-inch disks usually range from $40 to $55, but discounts of as high as 40 percent are available.

On the other hand, not all brands are the same. One simple test is to buy several brands and listen closely to the sounds made by the different disks as they are being formatted. If a spinning floppy sounds like coarse sandpaper, it probably is. You won't want it coming into daily contact with your disk-drive head. Save disks like that for making backup copies that you'll use once a year.

You, the Enemy

Now that you've chosen your disk, how do you feed and care for it? Mainly by heeding the following:

- Don't touch the exposed disk surface. When you're not using the disk, keep it in its protective sleeve.
- Don't bend the disk.
- Don't expose it to magnetic fields. Keep it away from electric appliances, telephones, and metal objects.
- Don't write on a disk (you'll scratch the magnetic coating). If you must write on the jacket, use a felt-tipped pen.
- Don't turn the system power on and off without removing the disk from the drive. Transient voltage can make your disk unreadable. Remove your disk before you touch the power switch.
- Don't stack disks more than 10 high or place heavy objects on disks. Store disks in a vertical position to avoid warping.
- Don't expose a disk to extremes in temperature. It can cause warping.

In addition to avoiding these seven deadly sins, there are a few preventive measures you can take to keep your disks free from dust and grime. Most important, perhaps, is to provide adequate, well-organized storage. It's also a good idea to clean the head every so often to remove the gradual buildup of magnetic-oxide deposits that can shorten the life of both the head and the disk. Disk-head cleaning kits should not be used too frequently, though, because the cleaner that removes the oxide buildup can also scratch the read/write head.

A disk-head cleaning kit comes in the form of a disk. You simply insert it in your disk drive, turn on the system, and let the head clean itself. Three varieties are carried by many computer dealers: BASF makes a dry cleaner, 3M makes a kit that includes both wet and dry cleaning, and Verbatim makes a disposable wet-cleaning variety.

You can store disks in an acrylic flip-top disk file that holds up to 50 disks. It helps keep disks organized, easy to find, and in an upright position. Some people like to use three-ring binders with vinyl storage pockets or those small plastic boxes that hold 10 disks each. Some experts say disks should be stored in metal boxes that interfere with stray magnetic fields—but then the metal box itself might become magnetized. So take your pick, but keep your disks organized and out of the way when they're not in use.

A Last Note

It's only appropriate to end this article with a warning: Floppy disks may be hazardous to your health. And I don't mean that facetiously. Safeguard your mental health by making backup copies.

Until recently, the only disk problem I had was forgetting to remove the write-protect tab. But all it took was an electrical storm to jolt me into reality. The pages of my rough draft (for this article, of course) were instantly zapped from memory, leaving me with a blank screen and a headache. Miraculously, only my program disk was affected; it wouldn't reboot. My data disk and my article were spared.

If you've had a similar memory-shattering experience (it only takes one to make you a believer), you know the importance of making backup copies of both your program disks and your data disks. Get into the habit of continuously backing up your data. Backup is a form of insurance; it doesn't have to be there until you need it. Here's hoping you never do. □

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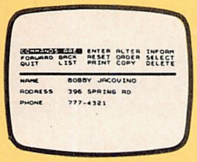
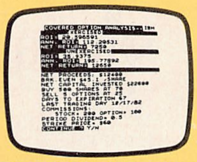
How to save on ZX81



```
COMMANDS ARE: ENTER ALTER INFORM
FORWARD BACK  RESET ORDER SELECT
QUIT    LIST  PRINT COPY  DELETE

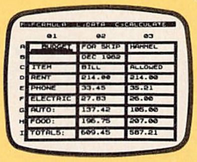
NAME       BOBBY JACOVINO
ADDRESS    396 SPRING RD
PHONE      777-4321
```

THE ORGANIZER An information storage program. Store the names, addresses, phone numbers, birthday and anniversary dates of your friends and business acquaintances.



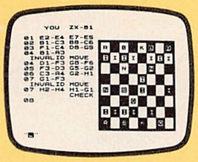
```
COVERED OPTION ANALYSIS..IBM
      EXERCISED
ROI: 20.596591
ANN. ROI: 112.20531
NET RETURN: 7250
      UNEXERCISED
ROI: 35.9375
ANN. ROI: 195.77892
NET RETURN: 12650
NET PROCEEDS: $12400
BRK.EVEN $45.1 /SHARE
NET CAPITAL INVESTED $22000
BUY 500 SHARES AT 70
SELL 5 OPTIONS AT 25
DAYS TO EXPIRATION 67
LAST TRADING DAY 12/17/82
COMMISSIONS:
    STOCK: 200 OPTION: 100
PERIOD DIVIDEND: 0.5
STRIKE PRICE: $60
CONTINUE? Y/N
```

THE STOCK OPTION ANALYZER Evaluate stock options quickly. Output includes an unexercised ROI, annual ROI, and NET worth. Last trading day calculated by computer.



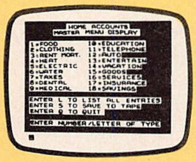
```
F:FORMULA  L:DATA  C:CALCULATE
      01          02          03
A    BUDGET    FOR SKIP    HAMMEL
B              DEC 1982
C  ITEM        BILL        ALLOWED
D  RENT        214.00      214.00
E  PHONE       33.45       35.21
F  ELECTRIC    27.83       26.00
G  AUTO:       137.42      105.00
H  FOOD:       196.75      207.00
I  TOTALS:     609.45      587.21
```

VU-CALC This program constructs, generates, and calculates large tables for financial analysis, budget sheets, and projections. An immensely powerful analysis chart.



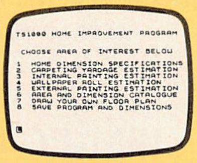
```
    YOU    ZX-81
01  E2-E4  E7-E5
02  B1-C3  B8-C6
03  F1-C4  D8-G5
04  B1-A3
  INVALID  MOVE
04  D1-F3  G8-F6
05  F3-D3  G5-G2
06  C3-A4  G2-H1
07  G1-F3
  INVALID  MOVE
07  H2-H4  H1-G1
           CHECK
08
```

CHESS AND CHESS CLOCK Six levels. All the legal moves including castling and enpassant. Keeps a separate record of plays made for easy reference. Play another opponent or match wits with the computer.



```
      HOME ACCOUNTS
   MASTER MENU DISPLAY
1=FOOD          10=EDUCATION
2=CLOTHING      11=TELEPHONE
3=RENT MORT.    12=AUTO
4=HEAT          13=ENTERTAIN
5=ELECTRIC      14=VACATION
6=WATER         15=GOODS
7=TAXES         16=SERVICES
8=DENTAL        17=INSURANCE
9=MEDICAL       18=SAVINGS
ENTER L TO LIST ALL ENTRIES
ENTER S TO SAVE TO TAPE
ENTER Q TO QUIT
ENTER NUMBER/LETTER OF TYPE
```

THE BUDGETER Keep track of your personal budgets and expenditures in categories such as food, clothing, rent/mortgage, medicine, education, savings, auto, and more.

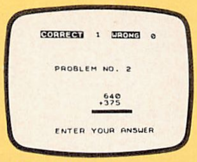


```
TS1000 HOME IMPROVEMENT PROGRAM

 CHOOSE AREA OF INTEREST BELOW

1   HOME DIMENSION SPECIFICATIONS
2   CARPETING YARDAGE ESTIMATION
3   INTERNAL PAINTING ESTIMATION
4   WALLPAPER ROLL ESTIMATION
5   EXTERNAL PAINTING ESTIMATION
6   AREA AND DIMENSION CATALOGUE
7   DRAW YOUR OWN FLOOR PLAN
8   SAVE PROGRAM AND DIMENSIONS
```

THE HOME IMPROVEMENT PLANNER Store up to 20 room measurements (length, width, height), compute total area in each (wall, floor), estimate costs of painting, wall papering and carpets and draw house blueprints.



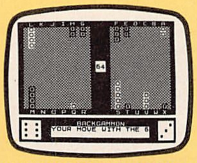
```
CORRECT  1  WRONG  0

  PROBLEM NO. 2

           640
          +375

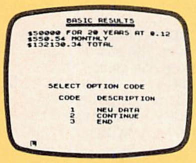
 ENTER YOUR ANSWER
```

SUPER MATH Drill yourself on addition, subtraction, multiplication, and division with five levels of difficulty. Each problem graphically depicted.



```
        BACKGAMMON
  YOUR MOVE WITH THE 6
```

BACKGAMMON AND DICE A perfect blend of chance and skill. Uses machine code to choose its moves. Full game including graphics board, rolling dice, and double cube. Play the computer or another opponent.

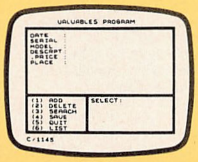


```
        BASIC RESULTS
$50000 FOR 20 YEARS AT 0.12
$550.54 MONTHLY
$132130.34 TOTAL


      SELECT OPTION CODE
       CODE    DESCRIPTION

        1      NEW DATA
        2      CONTINUE
        3      END
```

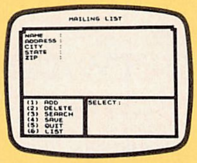
THE LOAN/MORTGAGE AMORTIZER Compare the cost of loans from different banks, review the details of your home mortgage. Be aware of the cost and how to minimize that cost.



```
      VALUABLES PROGRAM
DATE     :
SERIAL   :
MODEL    :
DESCRPT  :
.PRICE   :
PLACE    :

(1) ADD       SELECT:
(2) DELETE
(3) SEARCH
(4) SAVE
(5) QUIT
(6) LIST
C/1145
```

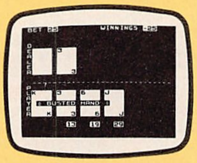
THE HOME ASSET MANAGER A home inventory program that can be very valuable in case of fire or theft. Records date of purchase, place of purchase, description, price, serial # and model #.



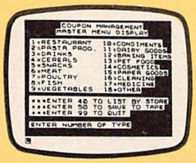
```
        MAILING LIST
NAME     :
ADDRESS  :
CITY     :
STATE    :
ZIP      :

(1) ADD       SELECT:
(2) DELETE
(3) SEARCH
(4) SAVE
(5) QUIT
(6) LIST
```

THE LIST MANAGER Mailing List—keeps track of personal or business mailing lists of up to 115 names by name, address or zip code. Phone Book—keeps track of personal or business numbers for up to 180 names.

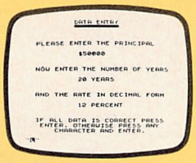


THE GAMBLER Match your Blackjack skills with the ZX81 or TS1000. Full graphical display of cards dealt and winnings. Includes Double Down, Min-Max betting. Also a Slot Machine complete with rolling tumblers, payoff values, and coin drop.



```
      COUPON MANAGEMENT
     MASTER MENU DISPLAY
1=RESTAURANT     10=CONDIMENTS
2=PASTA PROD.    11=DAIRY GOODS
3=DRINKS         12=BAKING ITEMS
4=CEREALS        13=PET FOOD
5=SNACKS         14=COSMETICS
6=MEAT           15=PAPER GOODS
7=POULTRY        16=CLEANING
8=FISH           17=MEDICINE
9=VEGETABLES     18=OTHER
***ENTER 40 TO LIST BY STORE
***ENTER 50 TO SAVE TO TAPE
***ENTER 99 TO QUIT
ENTER NUMBER OF TYPE
```

THE COUPON MANAGER Keep track of coupons you save showing what they are for, where they are offered, starting and ending dates for validity.



```
          DATA ENTRY

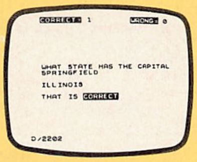
  PLEASE ENTER THE PRINCIPAL
            $50000

 NOW ENTER THE NUMBER OF YEARS
           20 YEARS

  AND THE RATE IN DECIMAL FORM
          12 PERCENT

  IF ALL DATA IS CORRECT PRESS
  ENTER. OTHERWISE PRESS ANY
     CHARACTER AND ENTER.
```

REAL ESTATE INVESTMENT ANALYSIS Two different investment strategies. The first selection allows the user to choose between renting or buying. The second selection consists of a detailed analysis of the rental investment property.



```
CORRECT: 1          WRONG: 0



WHAT STATE HAS THE CAPITAL
SPRINGFIELD

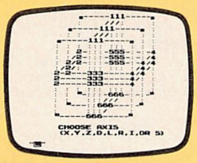
ILLINOIS

THAT IS CORRECT



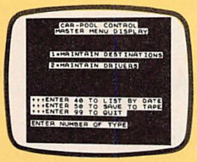
D/2202
```

STATES AND CAPITOLS Test yourself on the fifty states and their capitols. Three options of review are available. (1) States, you provide capitols. (2) Capitols, provide states. (3) A mix of states and capitols.



```
CHOOSE AXIS
(X,Y,Z,D,L,R,I,OR S)
```

THE CUBE GAME The cube can be displayed in three views: (1) Solid; (2) Two-Dimensional (unfolded); and (3) See-thru cube (3-D). You start with the cube solved, set it up any way you like, or pick up from a previous session.

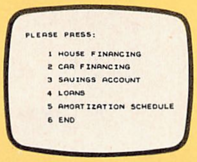


```
      CAR-POOL CONTROL
     MASTER MENU DISPLAY

  1=MAINTAIN DESTINATIONS
  2=MAINTAIN DRIVERS

***ENTER 40 TO LIST BY DATE
***ENTER 50 TO SAVE TO TAPE
***ENTER 99 TO QUIT
ENTER NUMBER OF TYPE
```

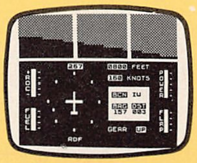
THE CAR POOLER Keep track of car usage by driver, destination, and date. Rider data and time of departure is logged.



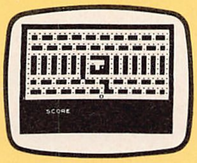
```
PLEASE PRESS:

    1 HOUSE FINANCING
    2 CAR FINANCING
    3 SAVINGS ACCOUNT
    4 LOANS
    5 AMORTIZATION SCHEDULE
    6 END
```

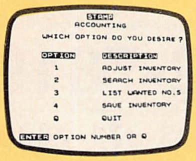
PERSONAL FINANCE PLANNER Perform calculations, finance a house, a car, keep savings accounts, repay loans and calculate an amortization schedule which can be generated for any of the financial programs.



THE FLIGHT SIMULATOR Take control of highly maneuverable light aircraft. With full controls, instrumentation and navigational aids to avoid hazards in landing.



GRIMM'S FAIRY TRAILS A super game involving a young prince trapped in a maze, being chased by relentless maze dwellers. You control the prince and the chase is on. Life crystals and sacred stones are the goal.

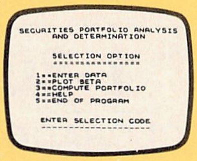


```
          STAMP
        ACCOUNTING
  WHICH OPTION DO YOU DESIRE ?

  OPTION      DESCRIPTION
    1         ADJUST INVENTORY
    2         SEARCH INVENTORY
    3         LIST WANTED NO.S
    4         SAVE INVENTORY
    0         QUIT

ENTER OPTION NUMBER OR 0
```

THE STAMP COLLECTOR Inventory and store up to 600 SCOTT numbers in a single session showing quantity on hand, by major classification, and provide full want list support.



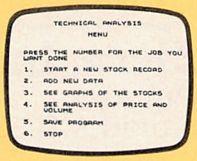
```
SECURITIES PORTFOLIO ANALYSIS
     AND DETERMINATION

     SELECTION OPTION
     ================

  1==ENTER DATA
  2==PLOT BETA
  3==COMPUTE PORTFOLIO
  4==HELP
  5==END OF PROGRAM

   ENTER SELECTION CODE
   --------------------
```

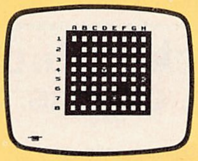
PORTFOLIO ANALYSIS Program performs minimum risk and market sensitivity calculations for a portfolio composed from a set of stocks. A portfolio is formed which gives the minimum amount of nonmarket risk for a given level of sensitivity.



```
      TECHNICAL ANALYSIS
            MENU

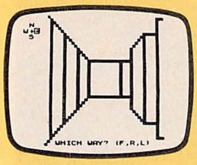
PRESS THE NUMBER FOR THE JOB YOU
WANT DONE
1.   START A NEW STOCK RECORD
2.   ADD NEW DATA
3.   SEE GRAPHS OF THE STOCKS
4.   SEE ANALYSIS OF PRICE AND
     VOLUME
5.   SAVE PROGRAM
6.   STOP
```

STOCK MARKET—TECH. ANALYSIS I Program uses "technical analysis" of price and volume data to forecast the direction of the Market or of any stock. Track up to 6 stocks without reloading. You need 30 trading days of data, closing price and day's volume. Analytical summary of each stock average is computed.

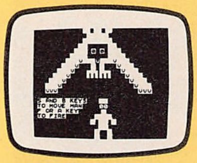


THE MIXED GAME BAG I Bowling—roll your ball down the alley controlling its flight from a keyboard.
Robot War—you are pitted against evil KORKON ROBOT in a duel of wits.
Bingo Caller—use ZX81 or TS1000 to randomly call a Bingo game.

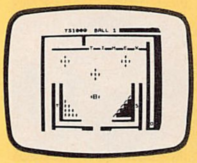
or TS1000 software.



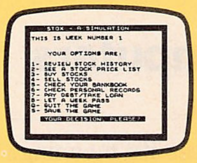
SUPERMAZE Navigate your way through a three-dimensional maze, with trapdoors, gold bars, marker stones, and compass. Ten separate mazes. Three-dimensional graphics.



BIGFLAP ATTACK You're being attacked by giant birds! To defend yourself shoot the birds right between the eyes. 10 levels of play ability.



PINBALL Plays like real pinball complete with flippers, bumpers, "nudge," bonus points and more. Uses fast, efficient machine code to choose its moves.

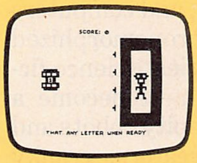


```
STOX - A SIMULATION
THIS IS WEEK NUMBER 1

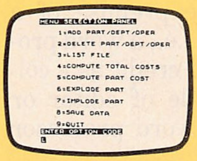
YOUR OPTIONS ARE:

1- REVIEW STOCK HISTORY
2- SEE A STOCK PRICE LIST
3- BUY STOCKS
4- SELL STOCKS
5- CHECK YOUR BANKBOOK
6- CHECK PERSONAL RECORDS
7- PAY DEBT/TAKE LOAN
8- LET A WEEK PASS
Q- QUIT THE GAME
S- SAVE THE GAME
YOUR DECISION, PLEASE?
```

STOCK MARKET GAME Bull or bear? This realistic simulation lets you analyze information, buy and sell stocks, take out and pay off loans. . . and win, if you can accumulate $50,000 in "The Market."

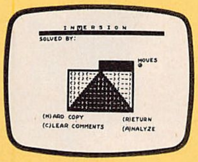


FORTRESS OF ZORLAC A super fast game in which you are the commander of a fleet of spaceships. Your mission is to rid the galaxy of the dreaded alien, ZORLAC.

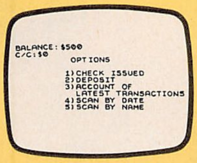


```
MENU SELECTION PANEL
      1=ADD PART/DEPT/OPER
      2=DELETE PART/DEPT/OPER
      3=LIST FILE
      4=COMPUTE TOTAL COSTS
      5=COMPUTE PART COST
      6=EXPLODE PART
      7=IMPLODE PART
      8=SAVE DATA
      9=QUIT
ENTER OPTION CODE
L
```

MANUFACTURING CONTROL A comprehensive manufacturing system. Monitor cost factors, track work in progress, keep daily account on details that mean profit or loss for up to 150 products.



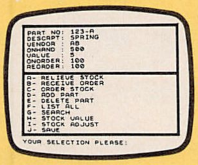
THE PUZZLER Comes with two options: Inversion and Double Inversion. Inversion takes at least 250 moves to solve it. Double Inversion is twice as hard.



```
BALANCE: $500
C/C:$0
            OPTIONS

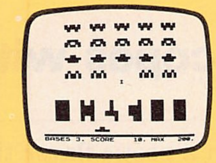
            1)CHECK ISSUED
            2)DEPOSIT
            3)ACCOUNT OF
              LATEST TRANSACTIONS
            4)SCAN BY DATE
            5)SCAN BY NAME
```

CHECKBOOK MANAGER A personal or business checking account program to store and sort banking transactions. On 90-minute tape, up to 3,600 transactions can be stored.



```
PART NO: 123-A
DESCRPT: SPRING
VENDOR : AB
ONHAND : 500
VALUE  : 5
ONORDER: 100
REORDER: 100
A- RELIEVE STOCK
B- RECEIVE ORDER
C- ORDER STOCK
D- ADD PART
E- DELETE PART
F- LIST ALL
G- SEARCH
H- STOCK VALUE
I- STOCK ADJUST
J- SAVE
YOUR SELECTION PLEASE:
```

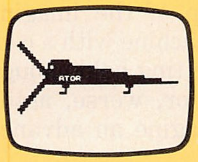
INVENTORY CONTROL STOCK I —keeps track of inventory levels, suppliers, re-order levels and types for up to 400 items. STOCK II —keeps track of inventory levels for up to 2,500 items.



SPACE RAIDERS, BOMBER Timex/Sinclair version of the popular arcade games full of bombs and rockets and collisions with skyscrapers.

FROGGER™
TM + (C) 1981 BY SEGA ENT. INC.
PRESS P TO PLAY
0000000

FROGGER Plays like the arcade game. Hop the frog over traffic, snakes, crocodiles, and treacherous diving turtles before time runs out.



ATOR THE ABC GATOR Designed to teach recognition and sequence of the alphabet. Combines computer instruction, music and video games.

Sinclair,* the company that invented the world's most affordable computer, has invented a way for you to order the most affordable software—right from your home!

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The more you buy, the more you save. A serious Sinclair software offer.

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Call toll-free: 800-543-3000. Ask for operator 509. In Canada call 513-729-4300, operator 509. Have your MasterCard or VISA ready when calling. Phones open 24 hours a day, 7 days a week. These numbers are for *orders only.*

If you simply want information, please don't call, write Sinclair Research, Ltd., 2 Sinclair Plaza, Nashua, NH 03061.

(Sorry, no refunds on software. Defective cassettes will be replaced.)

Call toll free

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Check the boxes of all cassettes you want.

☐ Check or money order enclosed.

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☐ The Budgeter #38
☐ Loan/Mortgage Amortizer #39
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☐ Car Pooler #40
☐ Stamp Collector #31
☐ Stock Option Analyzer #13
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☐ Home Asset Manager #47
☐ Real Estate Investment Analysis #30
☐ Personal Finance Planner #28
☐ Portfolio Analysis #41
☐ VU-CALC #11
☐ Super Math #14
☐ List Manager #45
☐ States and Capitols #32
☐ Flight Simulator #6
☐ Stock Market—Tech. Analysis I #46
☐ Chess #7
☐ Backgammon #8
☐ Gambler #43
☐ Cube Game #9
☐ Grimm's Fairy Trails #44
☐ Mixed Game Bag I #26
☐ Supermaze #34
☐ Bigflap Attack #42
☐ Pinball #35
☐ Stock Market Game #27
☐ Fortress of Zorlac #36
☐ Manufacturing Control #51
☐ The Puzzler #48
☐ Checkbook Manager #49
☐ Inventory Control #50
☐ Space Raiders, Bomber #5
☐ Frogger #37
☐ Ator the ABC Gator #33

Fill in the space beside total for your total payment

☐ 1 cassette: $15.00
☐ 2 cassettes: $25.00 (save $5.00)
☐ 3 cassettes: $35.00 (save $10.00)
☐ 4 cassettes: $45.00 (save $15.00)
☐ 5 cassettes: $50.00 (save $25.00)
☐ 6 cassettes or more: $10.00 each $________

Plus Shipping/Handling **$5.00**

Total: ________
U.S. Dollars

Name ________

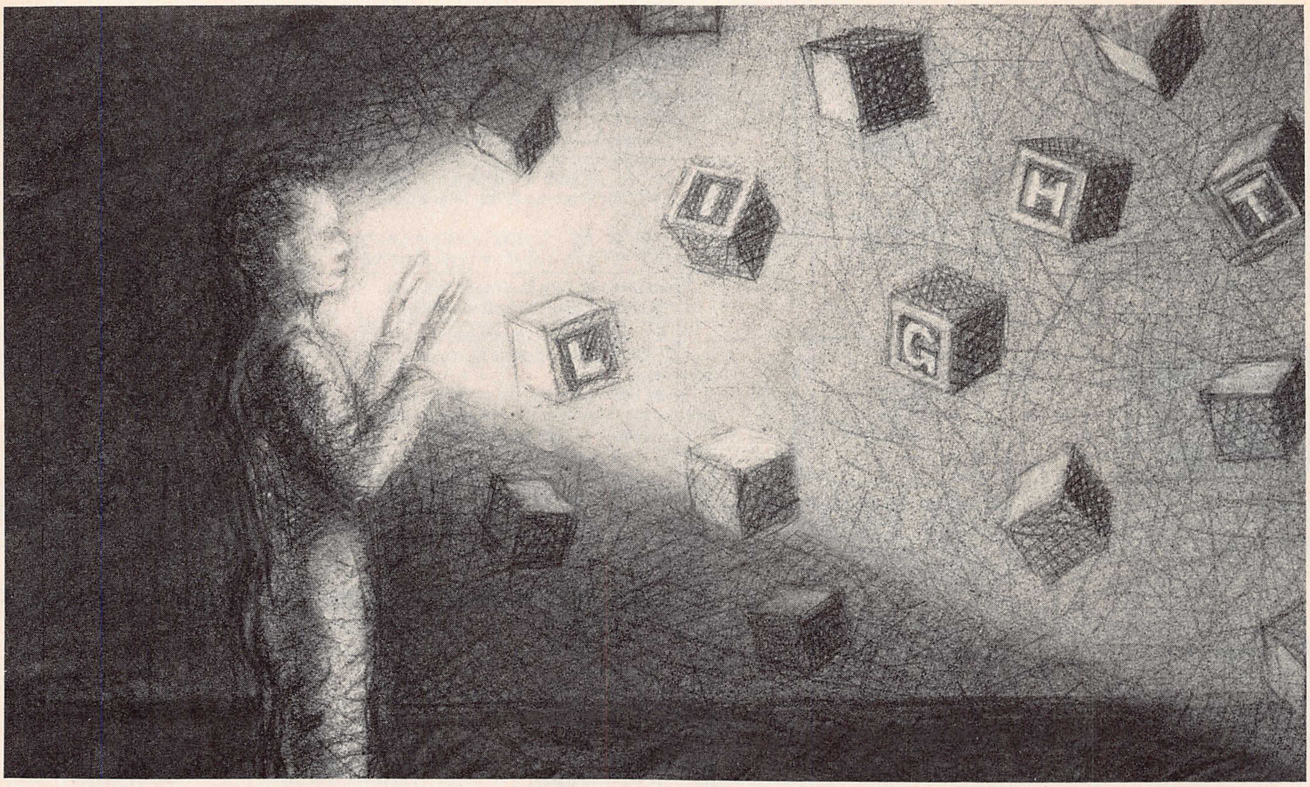
Street ________

City ________

State ________ Zip ________

*Sinclair technology is the heart of both the ZX81 and the Timex/Sinclair 1000.

sinclair



I Do Not Process Words!

How a tradition-conscious writer copes with computers

by Larry Tritten

I use a manual typewriter. Friends tell me that a word processor is better, more efficient, a marvelous invention, the tool of the future—at which point I generally find myself arching an eyebrow skeptically and speaking up in defense of my manual Olivetti, as if a close and loyal friend of 20 years had been condemned.

One thing that makes me uneasy about word processors is their name. *Word processor.* It's like a wound in the side of rhetoric. Try to imagine Abraham Lincoln processing the Gettysburg Address or Thomas Jefferson processing the Declaration of Independence. Process is a cold word with a bureaucratic connotation. I won't go so far as to claim that the natural environment of a word is a piece of paper and that words shouldn't be stored in a machine's memory, but I do think the term word processor needs some work. If word processors were called, say, lightwriters, I'll bet a lot of writers (who do not consider themselves processors) would be considerably less guarded about them. Lightwriter is a nice colorful word with a poetic flavor that enhances its meaning. It's the exact flipside of the term word processor, which is little more than two slices of linguistic cold bread.

Another reason why some writers resist the word processor is that it's really a computer, and computers in popular fiction have often been anthropomorphized in an unfavorable light. One of the hoariest science-fiction themes involves machines that have become a bane rather than a boon to mankind: uppity robots and automatons turning against their creators, cranky computers with messianic complexes, rebellious gizmos of all sizes and functions creating more problems than they solve.

Given this tradition of mechanical upstarts, it's a short leap of the imagination to the premise of a writing machine with a computer in it, i.e., a word processor, getting bold enough to demand credit as a collaborator or, worse, assuming the role of editor or critic. Imagine an advanced form of word processor

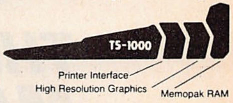
---

Larry Tritten, a freelance writer who lives in San Francisco, has written for *The New Yorker*, *Harper's* and the *Los Angeles Times*.

Illustration by Scott Reynolds

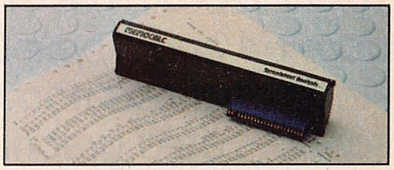
TIMEX MAKES THE COMPUTER, BUT WE MAKE IT TICK.

If you own a TS-1000 or ZX-81 computer and want to bring out the power within it, you'll want Memotech. From easier input to high quality output and greater memory, Memotech makes the add-ons you demand. Every Memotech peripheral comes in a black anodized aluminum case and is designed to fit together in "piggy back" fashion enabling you to continue to add on and still keep an integrated system look.

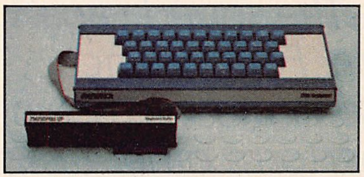


MEMOPAK 64K
MEMOPAK 32K
MEMOPAK 16K

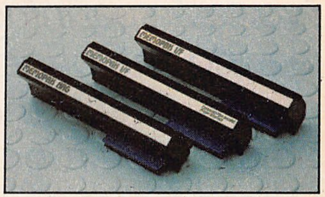
MEMOPAK RAM All Memopak RAMs are directly addressable, user transparent and are neither switched nor paged. No additional power supply is required. **16K RAM BASELINE** The 16K Baseline is our most economical way to add memory to your TS-1000. It is fully compatible with Memopak 16K and 32K RAMS to provide you with up to 32K or 48K of RAM respectively. **16K RAM** The Memopak 16K RAM offers expansion capabilities through its "piggy back" connection and is fully compatible with Timex or Memotech 16Ks to give a massive 32K of RAM. **32K RAM** The 32K Memopak enables you to execute sophisticated programs and store large data bases and like the 16K RAM is fully compatible with Timex's or Memotech's 16K RAMs to give you a full 48K of RAM. **64K RAM** The 64K Memopak is powerful enough to turn your TS-1000 into a computer with capabilities suitable for business and educational use. It accepts such BASIC commands as 10 DIM A (9000). **MEMOCALC** Memocalc, our spreadsheet analysis software, enables TS-1000 users to perform complex number crunching routines with ease. With the 64K RAM a table of up to 7000 numbers with up to 250 rows or 99 columns can be specified. Quick revisions can be achieved by entering new data to your formula.



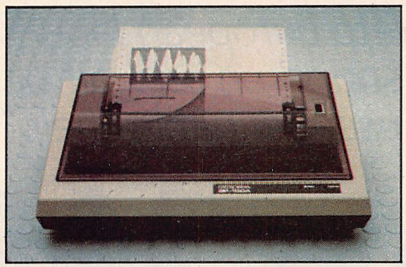
MEMOTECH KEYBOARD For ease of operation, the Memotech keyboard is a high quality standard typewriter keyboard, with TS-1000 legends. The keyboard is cable connected to a buffered interface which is housed in a standard Memopak case and plugs directly into the back of the TS-1000 or other Memopaks. **MEMOPAK HRG** The Memopak High Resolution Graphics, with up to 192 by 248 pixel resolution, enables display of high resolution "arcade game" style graphics through its resident 2K EPROM, programmed with a full range of graphics subroutines.



CENTRONICS PARALLEL AND RS232 INTERFACES
Memotech's Interfaces enable your TS-1000 to use a wide range of compatible printers. The resident software in the units gives the complete ASCII set of characters. Both Memopak Interfaces provide lower case character capabilities and up to 80 column printing. The RS232 Interface is also compatible with modems and terminals.



SEIKOSHA GP 100A PRINTER The Seikosha GP 100A uses a 5x7 dot matrix printing format with ASCII standard upper and lower case character set. Printing speed is 30 characters/second with a maximum width of 80 characters. The printer uses standard fanfold paper up to 9-1/2 inches wide. The GP 100A is offered as a package including cable and interface. Other printer packages are also available through Memotech.



ORDER AT NO RISK. All Memotech products carry our 10 day money back guarantee. If you're not completely satisfied, return it within ten days and we will give you a full refund. And every Memotech product comes with a **six month warranty**. Should anything be defective with your Memotech product, return it to us and we will repair or replace it free of charge. **Dealer inquiries welcome.** To order any Memotech product use the order coupon or call our toll-free number **800/662-0949.**

TS-1000 is a registered trademark of Timex Corp.

MEMOTECH
CORPORATION

7550 West Yale Avenue, Denver, Colorado 80227, 303/986-1516, TWX 910-320-2917

Mail To: Memotech Corporation, 7550 West Yale Ave., Denver, CO 80227
Code: POC-05

	Price*	Qty.	Total
16K RAM Baseline	$ 49.95		
16K RAM	59.95		
32K RAM	99.95		
64K RAM	149.95		
Memocalc	49.95		
Keyboard with Interface	99.95		
High Resolution Graphics	99.95		
Centronics Parallel Interface	74.95		
RS232 Interface	99.95		
Printer Cable	19.95		
GP 100A Printer Package**	399.00		
Shipping and Handling	4.95		$ 4.95
Tax (Colorado residents only)			
TOTAL			$

*All prices quoted in U.S. dollars. Prices and specifications subject to change without notice.
**Please add an additional $5.00 for printer shipping charges.

☐ Check ☐ MasterCard ☐ Visa

Account No. ____________ Exp. ______

Name ____________ (____) ______ Phone number

Address ____________

City ____________ State ______ Zip ______

ONLY

THE NEW ATARI 1200XL HOME COMPUTER MAKES SOPHISTICATED GRAPHICS AND SOUND SO EASY TO PROGRAM.

ONLY *the new ATARI 1200XL Home Computer combines custom microchip technology with 64K RAM computing power to deliver graphics and sound capabilities that are so easy to program. The ATARI 1200XL has 11 graphics modes and 5 text modes. (The Commodore 64 and Apple II-e have only 2 graphics modes and 1 text mode.) Additional text and graphics modes allow users to easily program sophisticated graphics effects with relatively few commands, taking full advantage of the 256 color variations available. The sound capabilities of the ATARI 1200XL are also easy to program. Four distinct "voices" spanning 3½ octaves are controlled by a separate microchip, leaving the principal microprocessor chips free to perform other tasks.*

ONLY *the ATARI 1200XL offers a keyboard featuring 8 programmable function keys controlling 16 functions in a 64K computer. (That's twice as many as the Commodore 64). Four new function keys enable you to lock and unlock the keyboard electronically, disable the screen DMA for faster processing time, generate European language or graphics characters, turn the keyboard sound on and off or access the one-touch cursor control. The unique user-definable "help"*

THE NEW

A Warner Communications Company

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key permits users to self-test ROM, RAM, audio-visual circuitry and keyboard functionality or call up assistance within complex programs. For even more help, Atari gives you a toll-free number to call for product and technical information (800) 538-8543; in California 1-(800) 672-1404.

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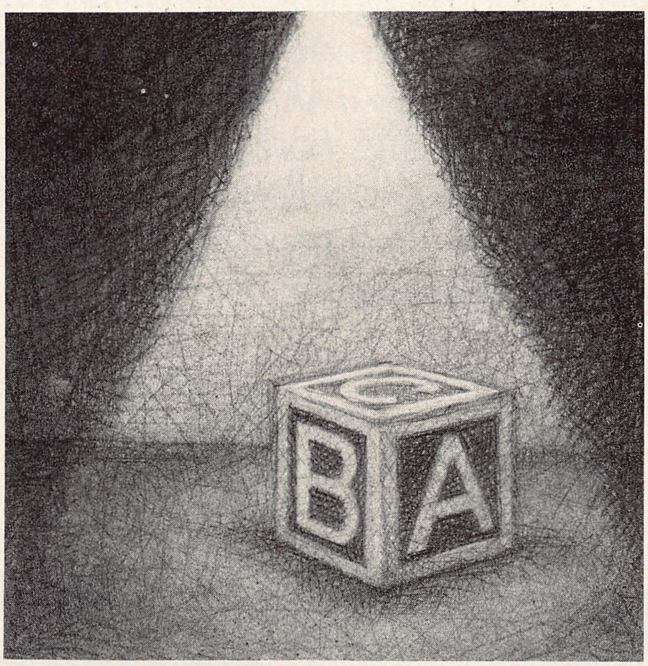
clucking its keys sarcastically after you've finished a paragraph and telling you in a voice like John Simon's that what you've done simply won't do. Imagine such a machine insisting on sharing the credit (if not claiming it) for some of your best material.

Then there is the matter of the word processor's screen. The word "screen" has filled writers with mixed emotions ever since Hollywood started paying writers a bundle for screenplays, a form of writing that reduces words to pictures. A screen is traditionally a framework for pictures, not words, and if there's one thing that nettles a writer it's the thought conveyed by the old aphorism "one picture is worth more than ten thousand words." It's easy for Hollywood-phobes to imagine a subliterate, post-McLuhan society in which the ultimate word processor turns writing directly into pictures. On such a machine you would type "It was a dark and stormy night" and the sentence would automatically be translated into a picture of a dark and stormy night. Movies would be created as easily as fast food. I'll bet *those* pictures wouldn't be worth ten thousand words, but I think there's a fair chance that people would gobble them up like Big Macs. Think of the slogan "Over 3 billion viewed." This may sound far-fetched, but literary style and linguistic purity are not exactly sacred icons of the public—or you wouldn't be able to get a Big Mac at McDonald's.



Imagine Ernie Pyle lugging a word processor through the Italian mud or Michael Herr using one in the Vietnam jungle.

I guess it can't be denied that a word processor helps a writer be more efficient and makes his job easier, but I can't help wondering if it doesn't somehow also undermine the intimacy of the act. I'm very style conscious, but I'm also a pragmatist about efficiency. Word processors surely add another dimension to the artist-versus-technocrat debate.

As magical as the word processor is, however, there is one application for which it isn't worth a handful of tail feathers from a greylag goose. A word processor is only vaguely portable, which greatly limits its use by writers who want to leap around outdoors. Ernie Pyle would have had a hell of a time lugging one through the Italian mud or Michael Herr through the jungles of Vietnam. They could just barely dodge shells carrying a typewriter. And Wordsworth could never have wandered lonely as a cloud with a word processor in his arms, or even an Osborne, for that matter.

The pen is the essence of portability, the quintessence of efficiency. The user of a word processor may proudly proclaim that two $5 floppy disks will hold a 300-page novel. But you can also get that kind of mileage with a ball-point pen.

For the freelance writer, the ultimate criterion is expense. A dedicated word processor can cost thousands more than a microcomputer set up for a variety of tasks, including word processing. And even the latter choice costs approximately $2000 and up, plus hundreds per year if the writer wants the protection of a service contract. That same money buys a whole lot of soup; hence word processing is beyond the pocketbook of many writers. If you've just closed a deal with Dino Di Laurentiis or knocked out a best-seller, no problem. But if you're writing for *The Paris Review* and hoping that George Plimpton will raise the rates to $150 because your adjectives are so well turned, you'd better reassess. Actually, there are lots of things the average writer could use just as much as a word processor, not the least of which are a trip to Hollywood (where he can sidle up to sun-tanned producers with fat wallets), New York (where she can meet Park Avenue editors and impress them with her worth), or Egypt (where he can study the hieroglyphics on tombs and reflect on the fact that this is how writing began—with pictures; though it certainly need not be how it will end, McLuhan notwithstanding).

In the best of all possible worlds, the writer would be paid enough by all and sundry to afford a complete laboratory of writing equipment, including a durable gold-plated pen, a manual and an electric typewriter, *and* a word processor. With so many implements to work with he might just discover a new vowel or consonant and help goose writing into the Twilight Zone, where all manner of possibilities await. ☐

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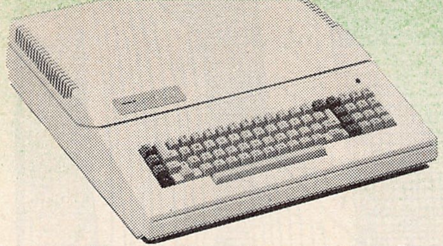

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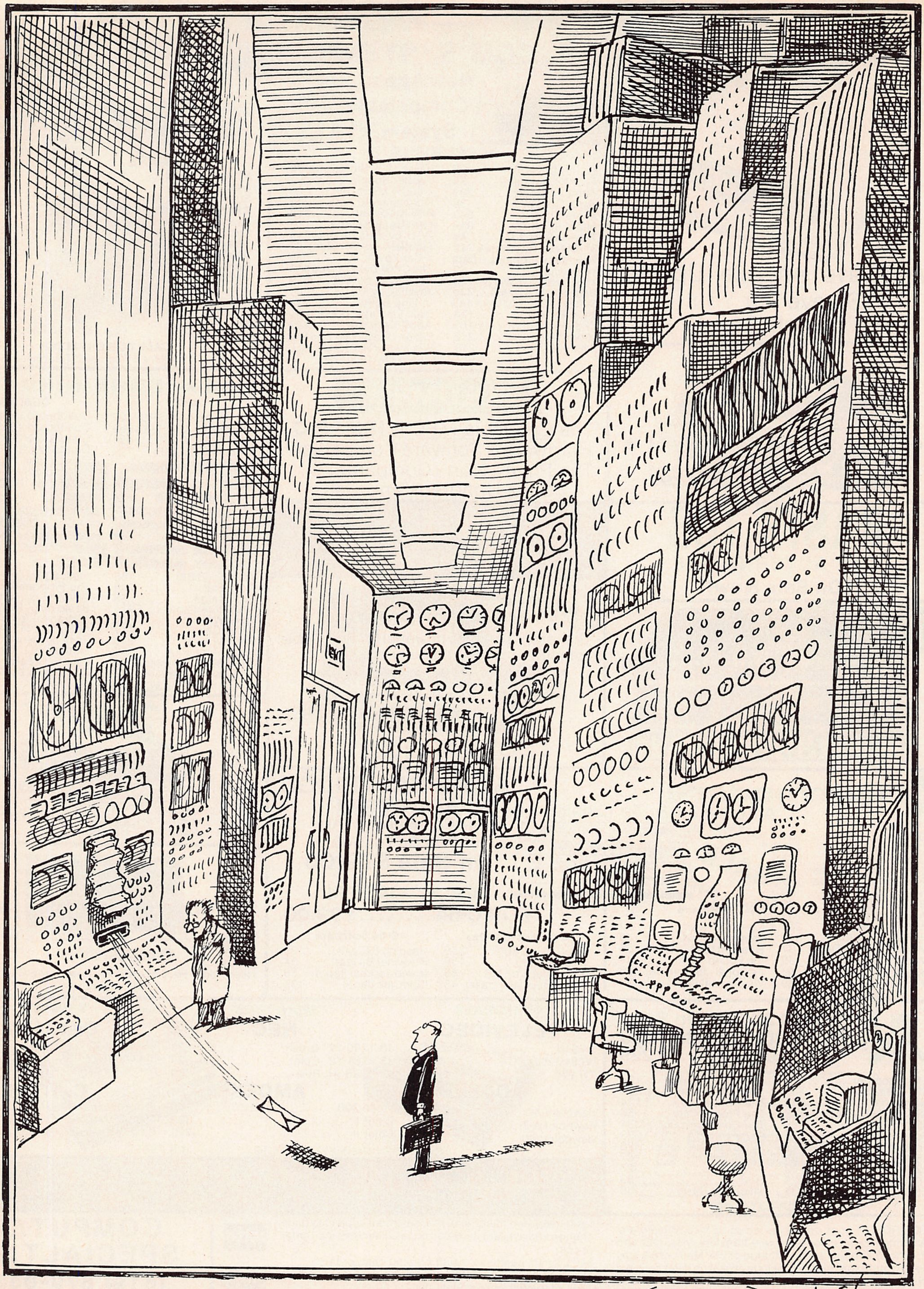

EXIT

The Automated Office: Myth Versus Reality

Electronic technology is moving into the office more slowly than expected. Word processing and electronic mail are gaining acceptance, but interactions among people are still the key to office productivity.

by A. Richard Immel

> *"Tell me, then, what you think of the . . . ." There Dr. Breeze paused, took a long breath, and puffed himself up to say in a stentorian voice, "the Office of the Future?"*
>
> *Perhaps it was the gathering blue dusk, the sense of disorientation created by the cluttered room, or the jet lag, the tiredness, the mental strain. Anyway I hear myself say:*
>
> *"There isn't going to be an Office of the Future."*
>
> *"Oh!" said Dr. Breeze in mock astonishment. "You must not let anyone hear such words." Blushing, he went to the door and closed it carefully, after looking to the left and to the right to make sure no one had heard my statement. When he came back, he spoke low, in conspiratorial tones.*
>
> *"Who are you, some kind of anarchist? Everybody is working on the Office of the Future, everybody is investing in it, and now you're saying it isn't going to exist. They'll kill you if they find out."*
>
> —imaginary dialogue between Jacques Vallee and Dr. Breeze, the Wise Gnome of Washington.*

It all started back in 1964 when IBM stuffed a magnetic-card recording device into a Selectric typewriter. The company called it a word processor, and offices haven't been the same since. Nowadays, of course, word processing is humdrum. The new catchwords are *multifunction workstation, knowledge workers, type I and type II offices*, and, the ultimate, *the automated office:* a paperless, push-button, electronic world where high finance meets high technology in a triumph of white-collar productivity. In the office of the future, company execs will send personal memos to employees 10,000 miles away with the touch of a button and instantly extract vital data for a board meeting from the company's electronic files. They will

---

*From Jacques Vallee's book *The Network Revolution; Confessions of a Computer Scientist* (And/Or Press Inc., Berkeley, CA, 1982).

A. Richard Immel is a contributing editor of *Popular Computing.*

Illustration by Eugene Mihaesco

browse electronically through video calendars and tickler files to schedule meetings with subordinates or check on overdue reports. And they will chat simultaneously with division chiefs in Pocatello, Auckland, and Buenos Aires via a televised conference at company headquarters.

This is all possible using today's technology, yet how many companies are doing all of this?

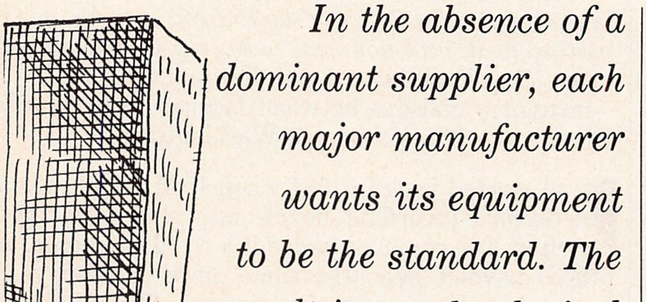
None. Zero. Zip.

The Pace of Innovation

That's not to say nothing is happening. Electronic technology is creeping into the business office as phone systems become computerized, word processors replace Selectric typewriters, and middle managers smuggle in personal computers to run spreadsheet programs like Visicalc. Electronic mail is being used here and there, and a few chief executive officers have even gone online by installing terminals in their executive suites.

Offices are gradually being automated, but there hasn't been the wild rush that many observers predicted a few years ago. Although the companies that sell equipment are still trying to convince corporate America that it needs fancy electronics to remain competitive, few businesses are buying that argument anymore, at least not in its entirety.

Offices are changing, of course, and much of this change has to do with silicon technology. "Office automation will play itself out in the micro revolution," asserts Patricia Seybold, a consultant and editor of *The Seybold Report on Office Systems.* She's talking about the microcomputer chip that will eventually change the way the business office works. It's just that the changeover is now coming more slowly than many thought it would several years ago.



In the absence of a dominant supplier, each major manufacturer wants its equipment to be the standard. The result is a technological Tower of Babel.

Seybold now says we're in "year one of a 10-year evolution," adding that she's "surprised by how long it takes people to absorb technology." She sees three main reasons for the present sluggishness: the economic recession, uncertainty about what office automation really is, and potential buyers' doubts about whether the new technology will pay for itself.

Jack Adams, a partner and office-automation specialist with Price Waterhouse and Company, agrees that "progress is being made, but at a much slower pace than we had assumed. I think people were dazzled by the possibilities of technology, but they underestimated the amount of time needed to introduce change." One result of that, Adams notes, can be seen in equipment sales patterns. "What's happened to many manufacturers is that sales of word processors and associated devices are going very well, but some of the sales expected of other technological advances in the 'office of the future' are not going very well."

This doesn't mean the market for the new office equipment is dead—far from it. Market researchers are still pumping out forecasts of enormous growth in sales of office technology over the next 5 to 10 years. In some cases, the numbers are astronomical: International Data Corporation, for example, projects cumulative expenditures of $180 billion for high-technology office equipment during the 5 years ending in 1986. Another marketing firm, International Resource Development Inc., sees expenditures for office automation rising to an annual level of $36 billion by 1990, three times the present yearly sales.

Automating the Office Worker

The basis for these forecasts is the expectation that companies are desperate to do something to improve white-collar productivity. As the American economy has become more service-oriented, salaries of white-collar workers have grown to become the dominant business expense. In some industries such as insurance, the white-collar payroll can account for 70 percent of a company's expenses. Given that statistic, however, it's not altogether clear whether this is a "problem" that office automation can remedy or just a condition of certain kinds of businesses.

Indeed, many feel that perhaps the amount of change that's really needed has been overestimated and that manufacturers and vendors of office automation equipment have pushed what they have to offer too hard. For example, when IBM first brought out its magnetic-card typewriters in the '60s, the company convinced customers to cluster equipment in word-processing centers to take advantage of what were thought to be economies of scale.

"It was a miserable failure," says Jay Kunin, a management consultant with Boston's Hammer & Company. "Managers said, 'You damned well won't take

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away *my* secretary,' and the secretaries said, 'I'm damned well not going to give up my job and sit in a typing pool all day.' " Most companies that tried IBM's suggestion have abandoned the idea of word-processing centers because the internal disruptions they caused actually lowered productivity rather than increasing it.

Centralized word processing is on the way out and no one is lamenting its demise, but the thinking that created it in the first place still exists. Many people fear that the office of the future could become a replay of the industrial assembly line and create a new battleground for labor and management. Organizations such as 9 to 5 (The National Association of Working Women) actively support improvements in equipment design and legislation that would guarantee clerical workers adequate health protection. "The equipment is neutral; it's how it's used that can be a problem," says a spokesperson for the 12,000-member union.

Putting It All Together

Despite the availability of a relatively wide range of new office technology, no company has yet put it all together. That's because it won't all *work* together. In the absence of a dominant supplier, each major manufacturer wants its equipment or its software to be the industry standard. The result is a technological Tower of Babel. In many cases even a company's own products are incompatible with each other. For example, Xerox, which has made a major commitment to wedge itself into the office automation market, introduced three major products in the past year that are not fully compatible with each other (a personal computer, an office word processor, and a state-of-the-art workstation called the Xerox Star).

Companies are lagging behind their customers' needs in other respects as well. They've been slow to design devices that are truly easy to use and consistent in function. All telephones and typewriters are essentially the same, but every word processor is different. Difficult situations arise when different brands or models of word processors are thrown together in an organization. While two keystrokes on one word-processing system will delete a word, on another system the exact same keystrokes will erase the entire document. This lack of consistency is analogous to different auto companies putting the brake pedal and the accelerator in different places.

"We've also seen a lot of failures in electronic mail," says Kunin. An electronic mail system uses desktop terminals attached to a communications network (usually telephone lines) to send messages directly from terminal to terminal. The problem is that the cost of each terminal—anywhere from $1000 to $3000—makes it difficult to justify the purchase of such a system if handling messages is all it does.

"It's a chicken-and-egg situation," claims Kunin. "The system has no value until you have enough people on it, but you can't justify putting enough people on the system until it has value to them."

Electronic mail presents conceptual problems too. To the extent that it removes communications barriers by channeling messages directly to an executive, it short-circuits more typical—and perhaps more desirable—office communications patterns. For the most part, senior executives neither read their mail nor write their own letters and memos (their secretaries do most of both); if there's no way to screen it, users of electronic mail can be deluged with unwanted messages. Moreover, electronic filing systems create the problem of controlling unauthorized access to confidential data.

Voice mail, on the other hand, *is* a practical technology because everyone already has the terminal—a telephone. A voice mail system converts messages into digital form and stores them in a computer's memory; the receiving party can recall a message by telephone at any time and have it reconverted into its voice form. Also called voice store and forward (VSF), this technology—rather like an elaborate answering machine—puts an end to "telephone tag," the all-too-common problem of two people failing to reach each other because one is out when the other calls back. While it's not good for all occasions, voice mail is a tremendous improvement in most cases, and unlike electronic mail, it's relatively cheap. VSF services are offered for a monthly fee; all you need is a Touch-Tone telephone system.

Video Teleconferencing

Video teleconferencing is another intriguing experimental technology, but again it's hard to justify because it's so expensive. Such a system requires a full TV channel to send and receive the signals, which generally means a trip to the phone company's facilities. Besides the expense of several thousand dollars an hour, video teleconferencing raises confidentiality questions because the entire session has to be monitored by phone company technicians (unless your company happens to have a two-way satellite-antenna link on the roof). The benefits of teleconferencing are yet to be proven. Avon Products is one example of an early user that has cut back because the video meetings lacked the creativity that comes from personal contact.

Foremost McKesson, a $4.5 billion drug, food, beverage, and chemical concern, has also experimented with teleconferencing. "It has a place as a communications tool," says Charles Hoerner, manager of office systems, adding that it could replace a significant amount of corporate travel. But Hoerner points out that it's not suited at all to situations in which the conferees don't know each other or persuasion or selling needs to be done.

Another office technology that's created more problems than solutions is local networking. The idea is to

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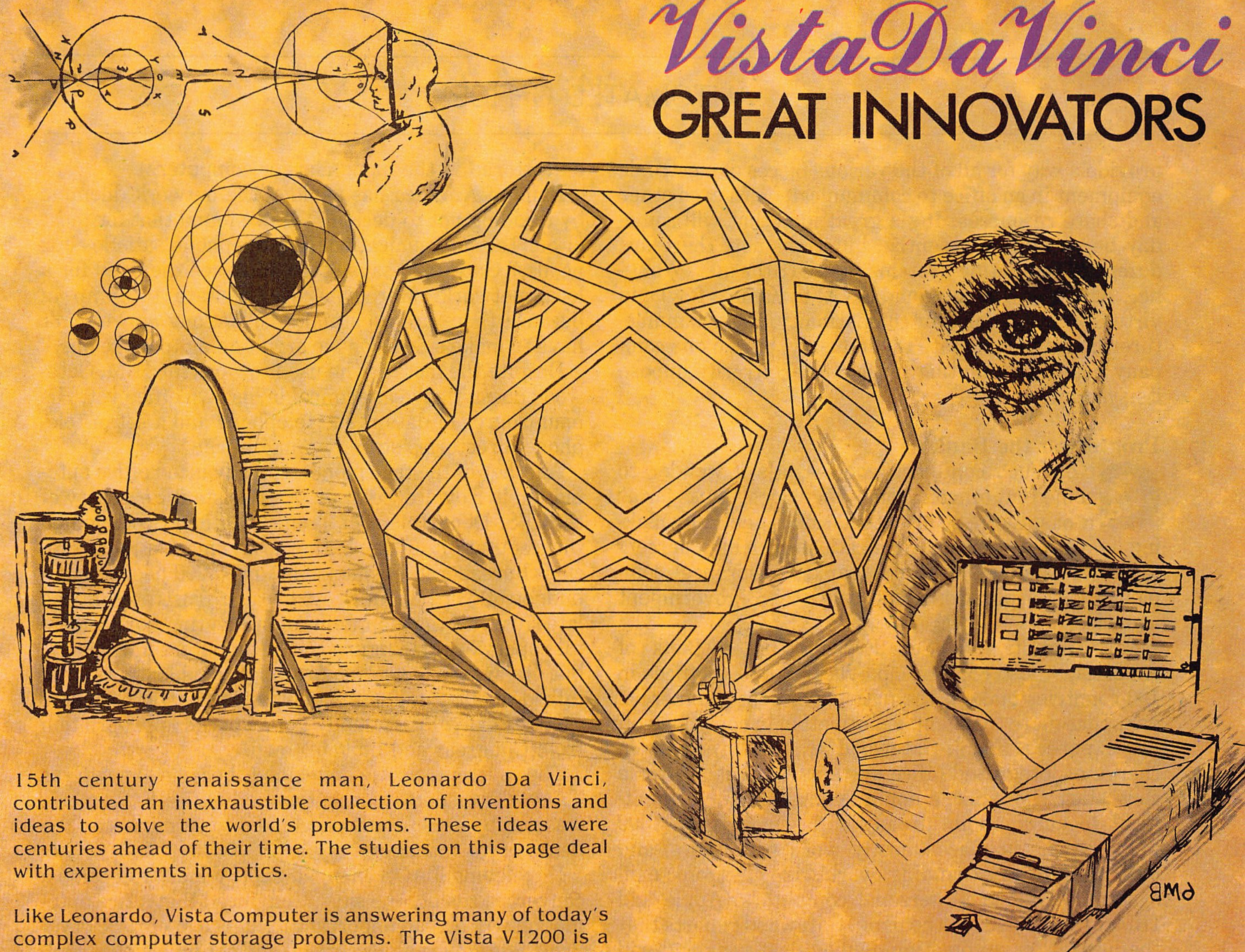

15th century renaissance man, Leonardo Da Vinci, contributed an inexhaustible collection of inventions and ideas to solve the world's problems. These ideas were centuries ahead of their time. The studies on this page deal with experiments in optics.

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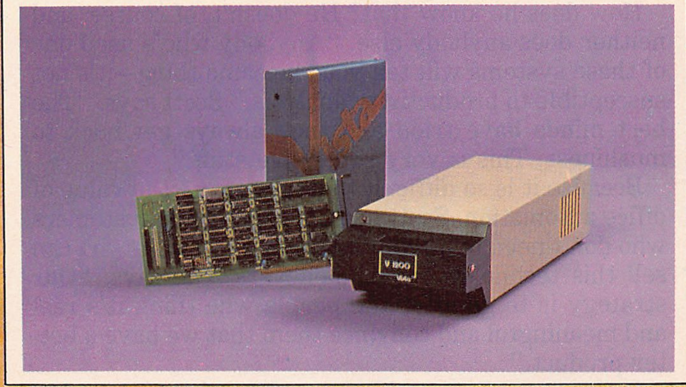

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TM IBM personal computer is a trademark of International Business Machines provide a way for all of the various pieces of electronic equipment in an office to communicate with each other and share resources. It's a great idea that will someday be absolutely essential, but right now there are dozens of competing systems in use (Ethernet, Wangnet, ARCnet, Omninet, and SNA, to name a few) and virtually no standards or compatibility. Each manufacturer hopes to dominate the industry, but no one company has the marketing muscle to arbitrarily impose its system.

Progress at the Bank

Given such confusing choices, it's a wonder to some that office automation has gotten as far as it has. Large-scale automation is generally making its biggest gains in organizations with high percentages of clerical workers—banks, insurance companies, oil corporations, and a few U.S. government agencies.

For example, the San Francisco-based Bank of America, whose 85,000 employees and 3000 offices in 100 countries make it the nation's largest commercial bank, has more than ample motivation to control its office expenses. Frank Gatewood Jr., vice-president in charge of integrated office systems, says that after a slow start the bank is now making a major commitment to automation: already it has more than 1000 workstations in place (mostly word processors) and 6000 users of an expanding, worldwide electronic mail system. About 1500 personal computers (Apple and IBM) are also used in the bank. Gatewood reports that the budget for automation doubled last year and will probably double again this year. By the end of the '80s, Gatewood says the bank will have invested $100 million in office automation, mostly in basic areas such as word processing, electronic mail, and information processing (i.e., using desktop terminals to work with data stored in the bank's larger computers).

Bank of America has avoided the network dilemma by deciding not to decide. "We've found that for most of our telecommunications the telephone satisfies our needs," Gatewood says. "We don't see the need for a local network. Moreover, we hesitate to jump in because there are no standards. As long as we don't have to make a decision we aren't going to make one."

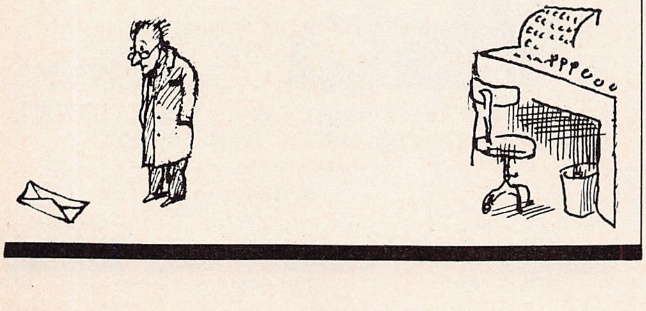
Despite the fact that he used to work for IBM, Gatewood doesn't have a terminal in his own office yet. His main source of data is the telephone and a set of telephone directories stored on microfiche.

Another of the true pioneers in advanced office automation is Edward Scott Jr. As Assistant Secretary of the U.S. Department of Transportation, Scott gained the reputation of being the government's most efficient bureaucrat. Responsible for 20,000 people and a budget of $17 billion, Scott became frustrated in the late '70s with the mountains of enervating governmental paperwork. He figured that computers might help, but he was equally frustrated by consultants who talked about terrific office systems not yet available commercially. Scott finally got a special appropriation from Congress and built his own.

The system Scott developed became known as TAOS (Transportation Automated Office System). It was run by a minicomputer linked to terminals on the desks of his managers.

Developing TAOS changed Scott's life. "I became a convert, a zealot," he says. Convinced that office automation will be "an important influence in our society," Scott left government service and set up his own company (now a part of Computer Consoles Inc.). Desk Power, his microcomputer-based executive office system, supports functions such as word processing, electronic filing, database access, and calendars on up to 16 terminals.

Offices are gradually becoming automated, but there hasn't been the wild rush that many observers predicted a few years ago.



Productivity in the Office: A Fuzzy Concept

Scott feels it will take another 10 or 15 years for technology like the system he developed to be accepted in most offices, but he has no doubt it will happen. "People simply can't afford not to have office automation," he says.

How does he know that? He doesn't, of course, and neither does anybody else. "Anybody who's used one of these systems will tell you the same thing—it's not susceptible to productivity analysis," Scott says. "The best minds have tried and they always get back to mushiness. This is very subjective stuff."

Because it is so difficult to demonstrate the value of office automation, Scott seeks out potential customers who don't need to be convinced. "I don't think you can sell this technology to nonbelievers," he says. "Our strategy is to go after the people who think it's real and meaningful and convince them that we have a better product."

In the expanding world of the office of the future few subjects create more heat than the question of productivity. How does a company justify spending hundreds of thousands of dollars on equipment that may not pay its way?

The figure for total white-collar salaries in the nation is put at more than $1 trillion annually, and it is rising. Using that number as a touchstone, Booz, Allen, & Hamilton, the New York management-consulting firm, has been pushing a detailed 15-company productivity study it completed two years ago. Booz, Allen researchers tabulated how "knowledge workers" (professionals, managers, salesmen, executives, etc.) spend their time each working day. The report concluded that installing appropriate electronic automation would eliminate anywhere from 10 to 30 percent of these workers' nonproductive time and that this would increase net income by more than enough to pay for the new equipment.

Critics, on the other hand, say that while office automation may yield benefits, it's very difficult to pinpoint them. Hammer & Company's Jay Kunin, for example, maintains that measuring managerial and professional productivity is fundamentally impossible. "At best that's the wrong approach; at worst it's getting you into questions that shouldn't be asked—unless for some reason you want to try to quantify the productivity of your managers by how many minutes they spend on the telephone," Kunin says.

Kunin's own approach is to look at the overall performance of the entire organization. Instead of using technology to do the same old things faster or more efficiently, Kunin recommends reexamining the basic premises behind what a company is doing and how it gets it done. Each organization is different, he claims, and electronic technology is far from being a panacea.

Price Waterhouse, a firm that also does a considerable amount of consulting on office automation, takes a similar approach. Improving the productivity of the organization may involve office automation, but the initial step is the old-fashioned one of determining what functions might be eliminated. As automation specialist Jack Adams says, "You'd be surprised how many there are. A well-conceived program [for increasing productivity] can pay for itself in cost savings in four to six months without any significant use of office automation."

Adams says that the company that decides to automate should do it a little bit at a time, starting with word processing, electronic mail, and voice mail. "Those are the things that are percolating to the surface as bread-and-butter applications," he says. "You can talk about the office of the future, but the body of the work system is word processing and its variations."

One would think that productivity in word processing could certainly be measured. Alas, even that has its soft edges. Keystrokes and error rates can be and are counted by office managers, making it possible to know if a secretary or clerk is putting out more or less paper per hour, but this is a valid measure only if the document being prepared is a final product. In cases where it is not, word-processing equipment may actually hinder productivity. Letters and documents tend to be rewritten more often, sometimes *much* more often, when the word processor replaces the typewriter. Whether the improvement in quality justifies the added cost is a difficult question.

Kunin cites the case of a big law firm that, after shifting to word processors, found some documents were being revised up to 40 times. In such a situation, is the fortieth revision significantly better than the thirty-ninth, or the thirty-third? "Who knows?" Kunin asks.

Bank of America, on the other hand, thinks automation is worth the expense. Frank Gatewood reports that one of the bank's loan units can now produce the paperwork involved in a commercial loan in one third the time it took with a typewriter. In one case an entire loan package was turned around in three days instead of two or three weeks. "That represented $65,000 in income to the bank in short-term loans," he says. "Word-processing technology lets you be very nimble; you're able to go after businesses you couldn't go after before."

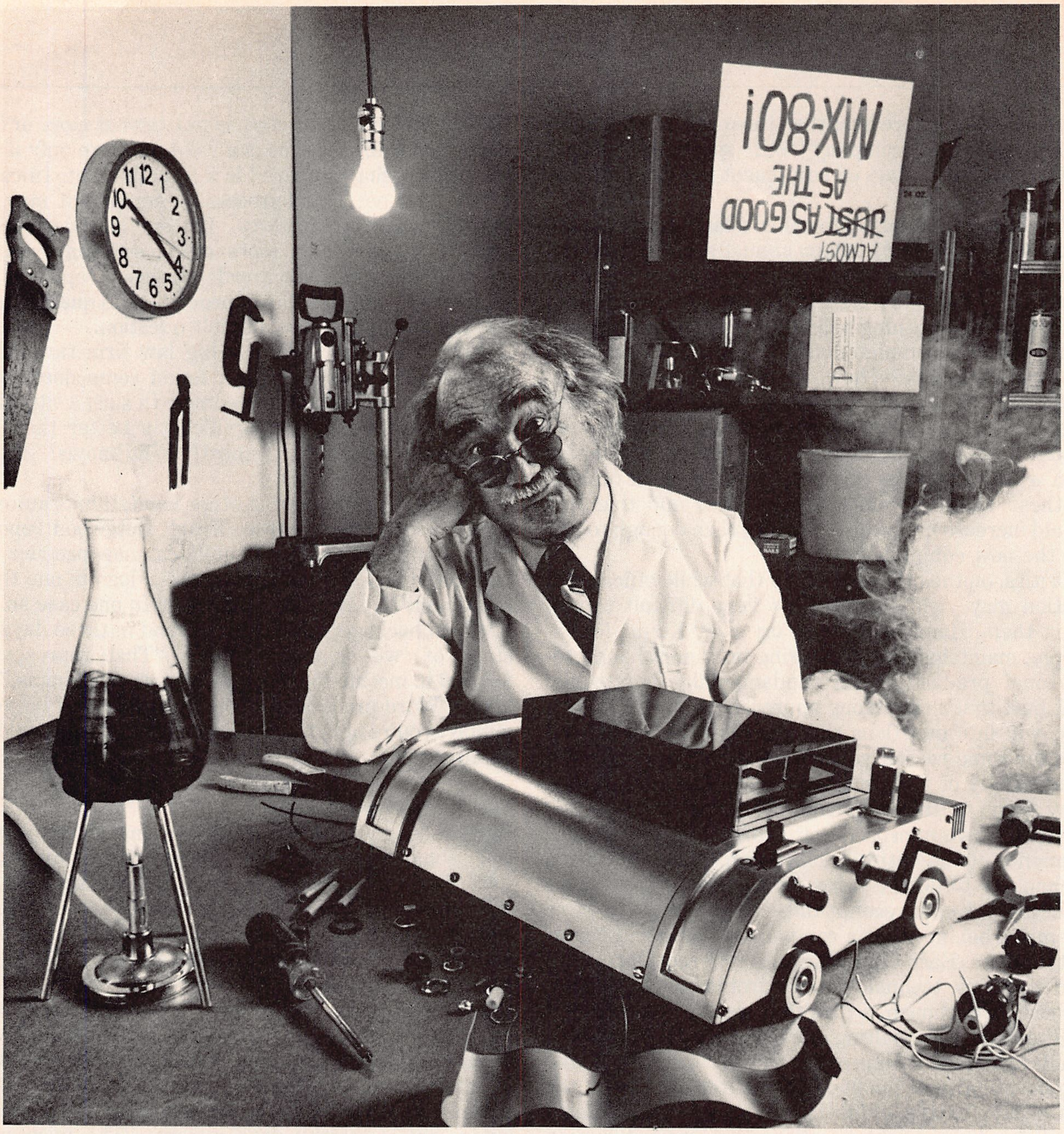
The Executive Computer

The joker in the office automation deck is the personal computer. Just how many are now being used in businesses is hard to say. Some estimates put the figure at close to 1 million (equivalent to the number of installed word processors, by the way) and predict a rise to 10 million over the next 10 years.

Many corporations don't even know how many personal computers are being used in their offices. Even when the number is known, just how these machines fit into the office automation puzzle is unclear. Jack Adams of Price Waterhouse thinks personal computers are a healthy development: "The microcomputer encroaches on everything—data processing, word processing, distributed processing, and timesharing."

David Ferris, a San Francisco software consultant, believes that the uncontrolled proliferation of personal computers could cause problems for many companies. Based on a study of 20 companies in the San Francisco area, Ferris predicts that as managers try to do more and more with their little computers, the companies' data-processing departments will be forced to take over software support of the machines. This, he says, will result in "painful solutions" because of the extra burden placed on already overworked data-processing departments.

Thomas Drohan, president and chief executive officer of Foremost McKesson, has other concerns. His company brought in about 20 IBM Personal Com-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So you can create "Sally's Gothic" or "Tom's Roman" just by downloading and modifying standard characters. Or you can create a custom set from scratch. Either way, you can store up to 256 new characters. And if you don't need a new alphabet, the RAM functions as a 2K data input buffer.

Who knows graphics better than Epson?

Nobody, that's who. And if you don't believe it, witness the FX-80.

With a 12K ROM capacity, the FX-80 gives you a few things the others don't. For example, not one, not two, but *seven* different dot addressable graphic modes are program selectable. And can be mixed in the same print line. Everything from 72 DPI (dots-per-inch) Plotter Graphics to the 640 dots per line resolution designed to match the remarkable monitor clarity of the Epson QX-10 personal computer.

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We'd be willing to bet that the FX-80 — like the MX-80 — will have its share of imitators. Don't be fooled. To make sure you get the genuine article, rush down to your local computer store right now and let them show you everything the FX-80 can do.

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puters last year as an experiment to see what they could do for managers. Even though Drohan recently got one in his own office, he has no thoughts of using it to run his company. But he does hope to replace "tons of marketing plans, projections, and interpretations of business data" with it.

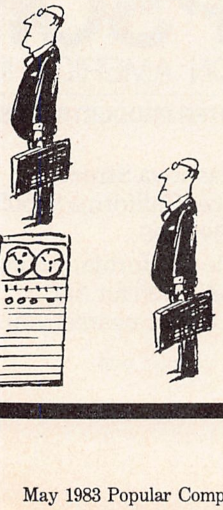
Foremost's foray into microcomputers is still very much in the experimental stage, Drohan emphasizes. One major question that still has to be addressed concerns access to stored data. Drohan sees it partly as an internal security problem, but he thinks it's also important that information-access priorities don't become indicators of status in the organization, like keys to the executive washroom. "That would be counterproductive," he says. "After all, the whole point of the personal computer is to break down that sort of thing."

Another awkward situation the personal computer is helping to break down is that old executive-suite syndrome known as keyboard phobia. Fear or dislike of keyboards isn't limited to top management, of course, but it's a significant factor in keeping terminals out of the reach of executives. The affliction seems to be the result of two things: the feeling that typing (*keyboarding* is the euphemism) is secretarial work, and the fact that most executives never learned how to type.

Keyboard phobia is curable, and it will probably die out by itself as younger executives who are more comfortable with such things climb the corporate ladder. Beyond that, it's probably only a superficial reason why the vast majority of top managers aren't going to be using computers or terminals of any kind in their offices for a long time to come. No matter what is said about executive information systems and decision support systems and whatever else they're called, chief executives simply don't need terminals to run their companies.

At Bank of America, Frank Gatewood is spending millions on office automation for senior administrators, including three electronic calendars just to keep up with bank president Sam Armacost's hectic schedule. However, Gatewood doesn't see any of this moving through the door into the boss's office for a long time. "Top executives do not need up-to-the-minute, real-time information," he explains. Their world, he says, involves "policy direction, historical performance, and prospects for the future." For such concerns they don't need a computer on the desk. "The executive terminal is an idea ahead of its time," Gatewood asserts. "I think it's 10 to 15 years away. It's going to happen, but for now our goal is to improve staff performance in support of that executive. That we know how to do."

Few subjects create more heat than the question of productivity. Many maintain that managerial and professional productivity is fundamentally not measurable.



But there was a twinkle in [Dr. Breeze's] eye that encouraged me to go on.

"If what you call an office is a square room with telephones and typewriters in it, then I agree with all the companies like Xerox and IBM that are building word processors and duplicators and voice recognizers and other electronic whatnots to expand their capabilities. That particular office of the future is going to happen of course. Whether we like it or not."

"So what are you worried about?"

He goaded me on, dizzy as I was, and I felt the tenseness in his old voice.

"I just don't think it's that simple. An office has people in it, you see. They have lives and ambitions and needs and emotions. They interact. Most of the 'productivity' everybody talks about comes from the interaction, not from the ability to write and process pieces of paper. And those machines will do nothing for the people interaction. So the benefits from having all that hardware may not happen for 10 years, or 20 years. . . ."

"And when they do happen?"

"By then other things will have changed drastically under pressure of the technology. So the real problem is much larger than making offices more productive. The real problem is to decide right now what human quantities and freedoms are worth fighting for, and which ones are not. Because when we are through with this digital transformation there won't be a stone left standing on another stone of our social edifice. There may still be a future, but there won't be an office to put in it."

—from *The Network Revolution; Confessions of a Computer Scientist*, by Jacques Vallee □

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FUTURE COMPUTERS

by Edward Jones

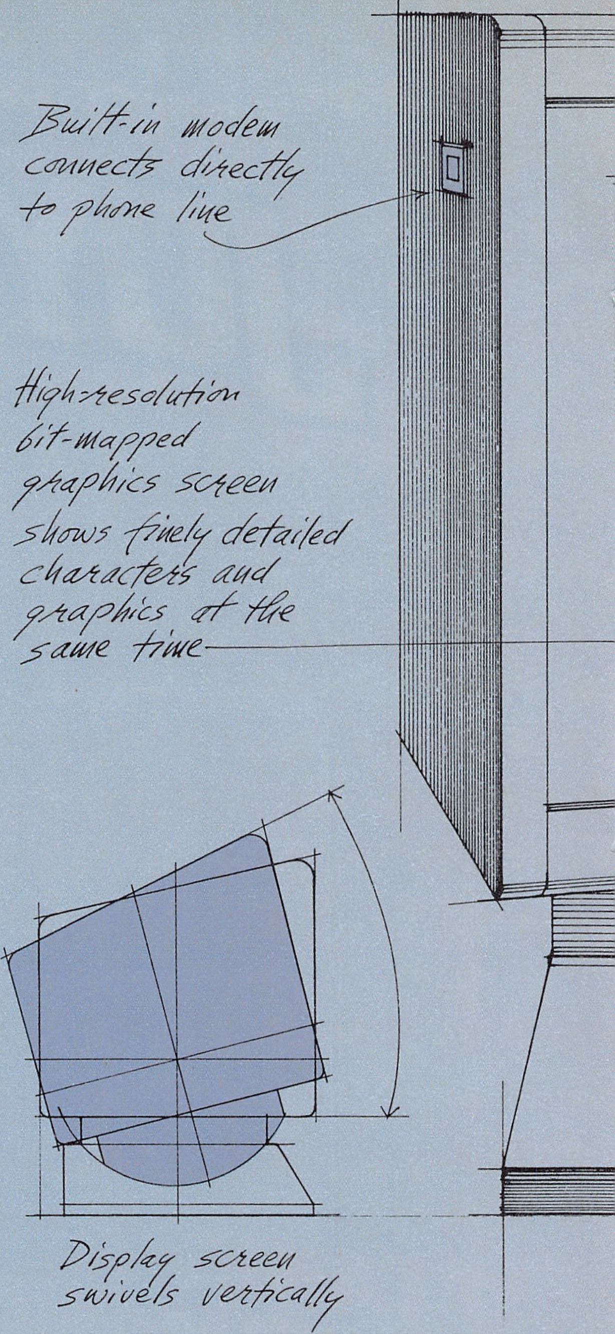
The personal computer has made a quantum leap in looks and capabilities in well under 10 years. It has evolved from a collection of hand-wired, balky circuit boards housed in a military-surplus metal cabinet into an integrated package that occupies its own niche in home or office. At the same time, the personal computer has evolved into a fairly standard form, although the wide range of available features and options allows for some variation.

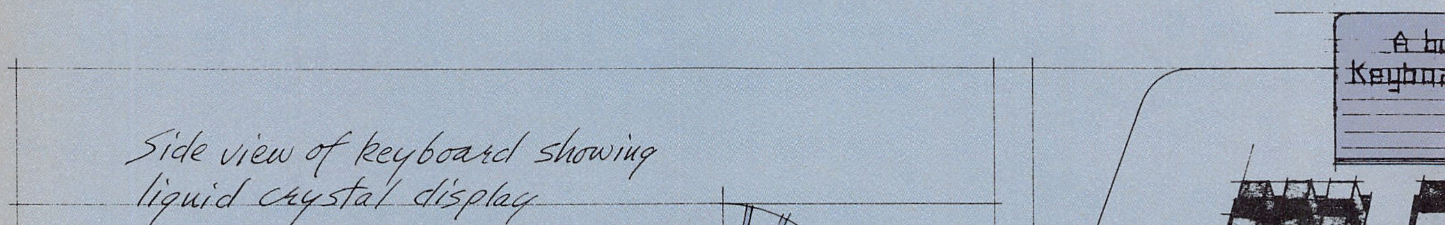
The components are here—just waiting to be put into place

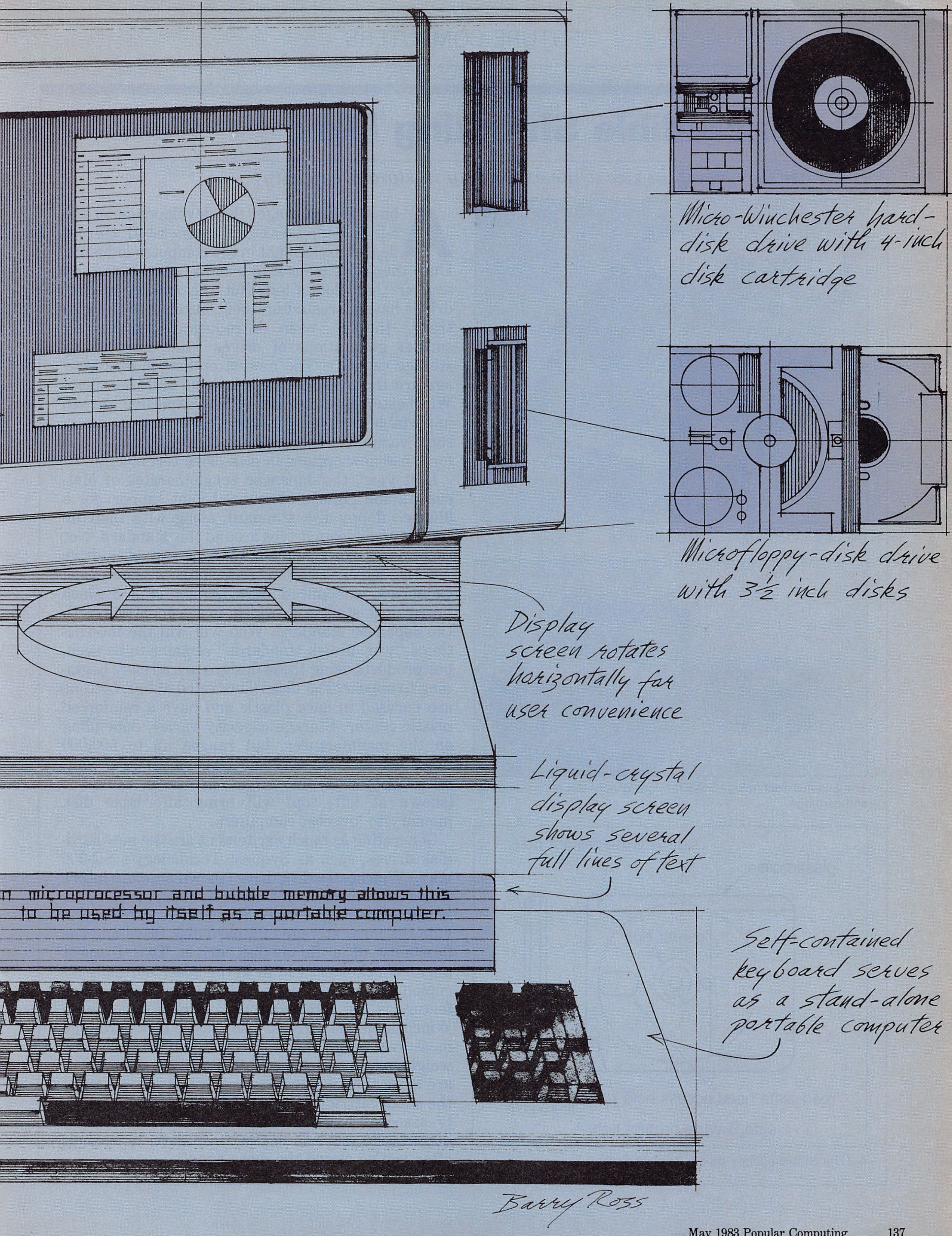
Today's computer system usually includes a video monitor (sometimes a television set) that displays standard alphanumeric characters and possibly graphics characters of various types. A keyboard is connected to the computer for data entry, and the software is loaded from, and saved onto, cassettes or 5¼- or 8-inch floppy disks. A printer uses tiny hammers punching against an inked ribbon to print characters on paper, and perhaps a telephone modem rounds out the package.

Within the next few years, however, a growing

Edward Jones is a freelance writer living in Dallas, Texas.


Built-in modem connects directly to phone line
High-resolution bit-mapped graphics screen shows finely detailed characters and graphics at the same time
Display screen swivels vertically


Side view of keyboard showing liquid crystal display tilted upward for easy viewing
A bu
Keyboa


n microprocessor and bubble memory allows this
to be used by itself as a portable computer.
Barry Ross

Micro-Winchester hard-disk drive with 4-inch disk cartridge

Microfloppy-disk drive with 3½ inch disks

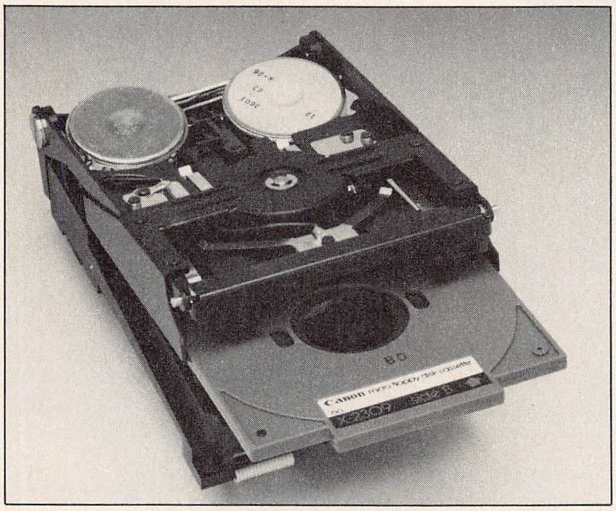
Display screen rotates horizontally for user convenience

Liquid-crystal display screen shows several full lines of text

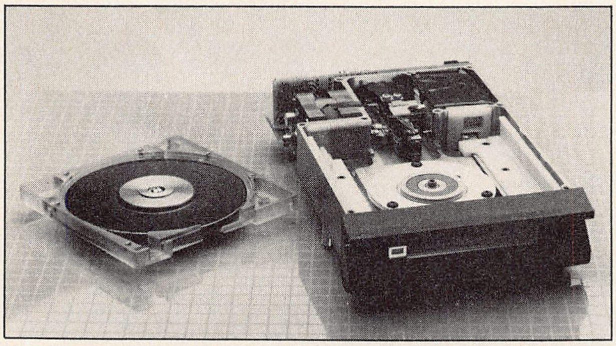
Self-contained keyboard serves as a stand-alone portable computer

The Incredible Shrinking Disk

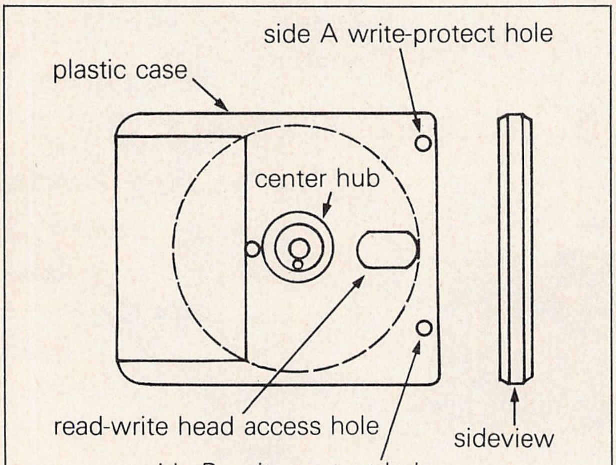
Disks are decreasing in size while expanding in storage capacity



The Canon CMD-500 microfloppy-disk drive.



The Syquest Technology SQ-306 micro-Winchester hard-disk drive and cartridge.



side A write-protect hole
plastic case
center hub
read-write head access hole
sideview
side B write-protect hole

A 3½-inch microfloppy disk in its plastic case.

About 10 years ago, the development of the 8-inch floppy-disk drive generated a great deal of excitement in the computer industry. Until then, it was hard to imagine disk drives any smaller than floor-sized. But the makers of disk drives haven't rested on their laurels. On the contrary, they've been introducing successively smaller generations of drives while maintaining storage capacity. The newest options in disk storage are the microfloppy-disk drive and the micro-Winchester hard-disk drive. The explosive growth in portable computers, smart typewriters, and personal computers in general will provide ample use for these new options in disk-drive technology.

Last year, the Japanese conglomerates of Matsushita and Hitachi announced joint support for a 3½-inch floppy-disk standard, along with their intention to develop drives around this standard. Not to be outdone, a number of American disk-drive makers, led by Shugart Associates of Sunnyvale, California, announced development of a 3½-inch floppy-disk standard, which is incompatible with the Japanese standard. Who will win the international "war of disk standards" remains to be seen, but products using these designs are already beginning to appear. The disks (illustrated at left, bottom) are encased in hard plastic and have a reinforced plastic center. Storage capacity varies, depending on the manufacturer, but ranges up to 500,000 bytes per disk. At a vendor price of $100 per unit, microfloppy-disk drives like the Canon CMD-500 (shown at left, top) will bring affordable disk memory to low-cost computers.

Generating as much excitement are the new hard-disk drives, such as Syquest Technology's SQ-306 micro-Winchester disk drive (shown at left, center). At an OEM price of $400 each, Syquest's SQ-306 removable-cartridge micro-Winchester drives provide the mass storage of a hard-disk drive and the flexibility of a floppy-disk drive. Two Syquest micro-Winchesters can fit in the space normally occupied by a single 5¼-inch floppy drive. An added feature is the removable disk, a new option with Winchester disk drives. The plastic disk cartridge measures roughly 4.3 by 4.4 by 0.5 inches and weighs all of 5 ounces. Built into this small space are more than 6 megabytes of disk storage. Due to the small cartridge size, the air-purge time normally associated with Winchester drives is not required—the drive is ready to operate 15 seconds after you've closed the drive door.

number of small changes will alter the look of the personal computer as we know it today. While individual components will still perform the same functions, the components themselves will undergo significant refinement. By combining all these changes in a single package, we've come up with a crystal-ball view of the state-of-the-art personal computer of 1988.

While you can't yet run down to your local computer store and pick up a computer of the future, the parts are under development or, in many cases, already starting to emerge. To examine these parts you need look only as far as the vendors who supply components for name-brand computers. Supporting the well-known companies like Atari, Apple, Commodore, and Tandy are a host of smaller firms with not-so-familiar names. It is an outpouring of products from these smaller firms such as Zilog, Intel, Shugart, Ball Electronic Display, and Qume that shows us the shape of things to come.

Putting the Future Computer Together

The 16-bit central processor of our future computer has already become a common feature in many machines. Within a few years 16-bit microprocessors will have replaced today's 8-bit processors as the brains of all medium-priced personal computers. The power of the 16-bit microprocessor—with its ability to directly address over 1 million characters of computer memory—will be needed to run software that is more flexible and easier to use than the software commonly used today. Microprocessor chips (such as Intel Corporation's 8088 and Motorola's MC68000) are already turning up in the more advanced personal computers on today's market. The OEM (original equipment manufacturer) price of $23 for Intel's 8088 microprocessor provides a lot of computing power for the dollar, and manufacturers of the Fortune 32:16, the Corvus Concept, and the IBM Personal Computer, among others, are putting that power to good use.

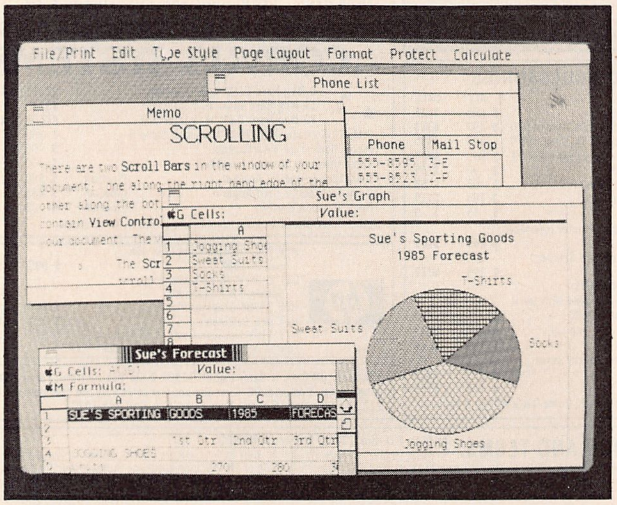
While you can't yet pick up a computer of the future at your local computer store, the parts are under development or already starting to emerge.

Most interesting, however, are the changes occurring in peripherals, accessories that expand a computer's usefulness. Disk drives have increased in capacity and flexibility while significantly decreasing in cost. And the introduction of microfloppy-disk drives for less than $200 will drive out the cassette tapes now used for storage with low-cost computers.

Our future computer uses a 3½-inch microfloppy as its main drive for loading programs. The floppy disks used in the drive are mounted inside plastic wafer cartridges and store up to 500,000 words (500K bytes, or half a megabyte) of data on a single cartridge. This type of drive has already found its way into the newly announced Sony SMC-70 personal computer (see "The Incredible Shrinking Disk" on page 138).

High-Resolution Bit-Mapped Displays

These displays give you high-quality images and great flexibility



The screen display of Apple's new Lisa computer.

High-resolution bit-mapped displays are now available on high-priced computers such as the Xerox Star (about $15,000), Apple's new Lisa computer (about $10,000), and the Corvus Concept (starting at about $5000). Bit-mapped displays use a separate memory location for each pixel (dot of light) on the screen. The Corvus Concept features a bit-mapped display with a resolution of 560 by 720 pixels, requiring 403,200 memory locations for the graphics images displayed on the screen. Apple's Lisa computer boasts a resolution of 720 by 364 pixels. This type of resolution makes possible high-quality images like the one shown at left. At present, the relatively high cost of computer memory makes such displays too expensive for most personal computers. As the cost of electronic memory continues to decline, bit-mapped displays should become standard features on low-cost computers.

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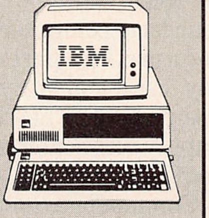

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8" CP/M-80

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	Zork I or Zork II or Zork III or Starcross, each		$ 50	$ 39
	ISM, MatheMagic		$ 100	$ 75
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Micro Telegram for Apple II	$ 250	$125
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Stock Smartmodem (RS-232)	$ 289	$225
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	ANADEX, DP8000 Dot Matrix, 120cps, Serial & Cent. Para. I/F	$ 995	$495
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	Apple Interface and Cable for Epson or Gemini	$ 95	$ 59
	Grappler+ by Orange Micro, specify printer	$ 165	$119
	Apple Graphics Dump Program	$ 15	$ 9
	MICRO TEK, Apple Dumpling GX, Graphics Printer Interface with Cable	$ 249	$169
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	A70, 5¼", 286K Disk Drive	$ 599	$459
	Controller for A40 or A70	$ 100	$ 79
	Filer, Disk Utility Software	$ 20	$ 15
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CCS, Serial Interface 7710A	$ 150	$129
Centronics Interface 7728	$ 110	$ 85
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Centronics Interface 7720B	$ 120	$ 95
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HARDWARE

for Apple II

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★	**ALS**, ADDRam 16K	$ 149	$ 79
★	**Microsoft**, RAMCard 16K	$ 100	$ 89
★	**Saturn Systems**, RAM Card 32K	$ 249	$169
	RAM Card 64K	$ 425	$319
	Axlon, RAM Card 128K	$ 475	$375
	RAM Disk System 320K	$1395	1995

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	ALS, Smarterm II	$ 179	$139
	Dirt Cheap Video	$ 89	$ 69
	Videx, Videoterm	$ 345	$229
	Vista, Vision 80	$ 395	$199

MISCELLANEOUS

★	**ALS**, The CP/M Card	$ 399	$299
	Z-Card	$ 169	$129
	16K ADDRam Special	$ 149	$ 79
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	Color II	$ 179	$139
	Axlon, 320K RAM Disk System	$1395	$995
	ASTAR, RF Modulator	$ 35	$ 25
	CCS, Serial Interface 7710A	$ 150	$129
	Other CCS Cards in stock	Call	Call
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	Don't Ask, DAO-003 S.A. Mouth	$ 125	$ 85
★	**Eastside**, Wild Card, copier	$ 130	$ 99
	Kensington, System Saver	$ 90	$ 69
	Kraft, Joystick	$ 65	$ 49
	Paddle	$ 50	$ 39
	M&R, Sup R fan	$ 50	$ 39
★	**Microsoft**, Z80 Softcard	$ 345	$245
★	Softcard Premium Pack	$ 695	$495
	Z80 Softcard Plus	$ 645	$459
	16K RAMCard	$ 100	$ 89
	Micro Tek, Dumpling GX, Graphics Printer I/F	$ 249	$169
	Dumpling 64, Buffered 64K Spooler	$ 349	$239
	Mountain, CPS Multifunction Card	$ 239	$199
	Orange Micro, Grappler Plus	$ 165	$119
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	MBP 16K Para (Epson)	$ 159	$129
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on disk for Apple II/II+/IIE

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	50% off other Apple Inc. software		Call
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	Artsci, MagicWindow II New!	$ 150	$ 99
	Ashton-Tate, dBase II (CP/M) with User's Guide by Software Banc	$ 730	$439
	Continental, GL, AR, AP or PR. ea.	$ 250	$169
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	Home Accountant	$ 75	$ 49
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	ReportStar	$ 350	$229
	WordStar® + Training Manual	$ 495	$199
	MailMerge T.M.	$ 250	Call
	SpellStar T.M.	$ 250	Call
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	Data Star T.M.	$ 295	Call
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★	**Silcon Valley**, Word Handler	$ 250	$139
	Sof./Sys., Executive Secretary	$ 250	$169
	Executive Speller	$ 75	$ 55
★	**Solidus**, Stockfile	$ 600	$350
	Software Dimensions/System Plus,		
	Acctg. Plus, General Ledger	$ 425	$295
	Acctg. Plus, GL, AP and A/R	$ 995	$595
	Acctg. Plus, above + Inventory	$1395	$775
	Software Publishing, PFS II	$ 125	$ 85
	Report	$ 95	$ 65
	Graph	$ 125	$ 85
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	STC, The Creator NEW!	$ 200	$139
	Stoneware, DB Master	$ 229	$155
	DB Utility I or II	$ 99	$ 69
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★	Applewriter II preboot disk	$ 20	$ 15
	Visicalc to 64K preboot disk	$ 50	$ 39
	Viscalc to 176K preboot disk	$ 90	$ 69
	VisiCorp/Personal Software,		
★	Visicalc 3.3	$ 250	$179
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	Central Point Software		
★	Filer, DOS Utility	$ 20	$ 15
★	Copy II Plus (bit copier)	$ 40	$ 35
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	Insoft,		
	GraFORTH by Paul Lutus	$ 75	$ 59
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	Microsoft,		
	A.L.D.S.	$ 125	$ 75
	BASIC Compiler	$ 395	$299
	Cobol 80	$ 750	$559
	Fortran 80	$ 195	$149
	TASC Compiler	$ 175	$159
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	Graphics Magician New!	$ 60	$ 41
	Phoenix, Zoom Grafix	$ 40	$ 29
	Quality, Bag of Tricks New!	$ 40	$ 29
	Saturn Systems, VC-Expand	$ 100	$ 49
	VC-Expand 80	$ 125	$ 69
	Sensible, Back It Up, (bit copier)	$ 60	$ 49

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	Arcade Machine	$ 45	$ 40
	Choplifter New!	$ 35	$ 26
	Many others		Call
	Budgeco, Raster Blaster	$ 29	$ 22
	Continental, Home Accountant	$ 75	$ 49
	Datamost, Snack Attack	$ 30	$ 24
	Datasoft, Canyon Climber New!	$ 30	$ 23
	Edu-Ware, Several in stock	Call	Call
	Auto. Simulations,		
	Introductory 3-Pack	$ 50	$ 35
	Hayden, Sargon II (Chess)	$ 35	$ 29
	Infocom, Deadline	$ 50	$ 38
	Insoft, Electric Duet by Lutus	$ 30	$ 25
★	Zargs New!	$ 35	$ 27
	Spider Raid New!	$ 30	$ 24
	Lightning, Mastertype	$ 40	$ 29
	Microsoft, Olympic Decathlon	$ 30	$ 24
	Typing Tutor II	$ 25	$ 15
	Muse, Robot War	$ 40	$ 29
	Castle Wolfenstein	$ 30	$ 23
	On-Line, Frogger New!	$ 35	$ 25
★	Ultima II	$ 55	$ 40
	Softporn (X Rated)	$ 30	$ 22
	Piccadilly, Warp Destroyer	$ 30	$ 23
	Sirius, Gorgon	$ 40	$ 29
	Sir-Tec, Wizardry	$ 50	$ 39
	Knight of Diamonds. New!	$ 35	$ 26
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For even more mass storage, our computer's second drive is a 4-inch Winchester hard-disk drive that costs $400 in large quantities. At least one manufacturer, Syquest Technology of Freemont, California, has announced the drive, and other firms are expected to release similar products throughout 1983. Syquest's 4-inch Winchester drives use removable cartridges storing slightly over 6 million bytes of information each. Syquest's cartridges, called "Q-Paks," are expected to sell for between $50 and $100.

The power of the 16-bit microprocessor is its ability to address over 1 million bytes of computer memory. This lets it run software that will be more versatile.

For applications that demand even more storage than the new generation of micro-Winchesters can offer, another option on our future computer is the laser-disk drive. A laser-disk drive is currently under development by Optimem, a subsidiary of Shugart Associates, a well-known disk-drive manufacturer. The laser-disk drive has one drawback: it can read the same data many times but will write data only once. The storage capacity of approximately 1 gigabyte (1 billion words of information) makes such a disk ideal for storing entire reference works, such as the text of an encyclopedia or a New York City telephone directory. Optimem's laser-disk drive is expected to be released later in 1983.

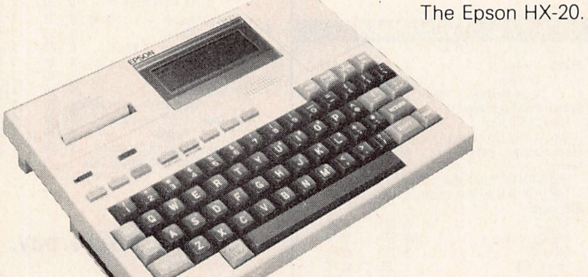
Another feature available today, although at high cost, is the bit-mapped display screen (see "High-Resolution Bit-Mapped Displays" on page 139). Currently featured in a few high-end personal computers such as the Corvus Concept ($4995), a bit-mapped display significantly increases the clarity and definition of graphic images on the screen. In a bit-mapped system, a single memory location within the computer controls each dot of light on the screen.

While the advantages of such a system are literally easy to see, the increase in memory cost has prevented bit-mapped displays from becoming more prevalent. As the cost of memory continues to drop, more medium-priced systems will adopt bit-mapped technology. One monitor manufactured today by Ball Electronic Display is capable of such finely detailed displays when used in a bit-mapped system. It sells for about $300 and is capable of presenting two pages of information on the screen simultaneously. The display screen of our future computer also swivels and tilts for optimum viewing.

The keyboard of our computer has borrowed its

The Portable Computer Keyboard

With its built-in microprocessor, a keyboard can act as a stand-alone computer



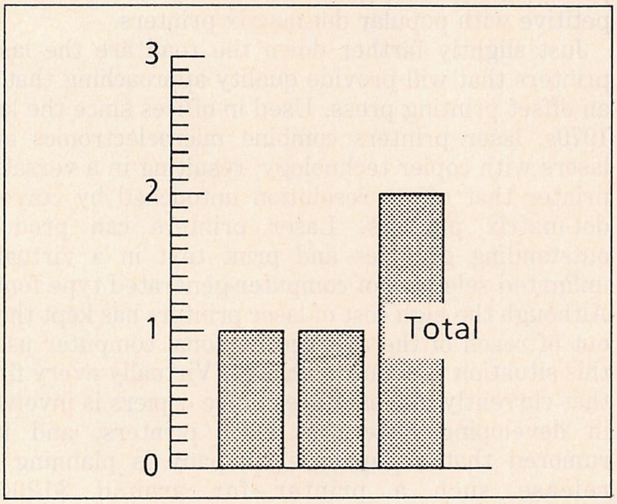
The Epson HX-20.

The Teleram T-3000.

Larger than the tiny Timex/Sinclair 1000 or the Radio Shack Pocket Computers but significantly more compact than "portable" computers like the Osborne 1, briefcase-sized portables with full-sized keyboards are the forerunners of the detachable keyboard on our computer of the future. Such a keyboard could be used in a stand-alone mode and still serve as a keyboard for a larger system. Selling for less than $800, the Epson HX-20 (shown at left, above) has a four-line liquid-crystal display, a tiny built-in printer, and the ability to interface with many other devices. It holds up to 32K bytes of random-access memory (RAM), which does not disappear when you turn the power off. The Teleram T-3000 (shown at left, below) sells for about $3000. It has a full keyboard with a 10-key numeric keypad and displays four 80-character lines. It also has 256K bytes of nondisappearing magnetic bubble memory, as well as 64K bytes of conventional RAM. The Radio Shack TRS-80 Model 100, reviewed on page 86 in this issue, is another outstanding example of the state of the art in briefcase-sized computers.

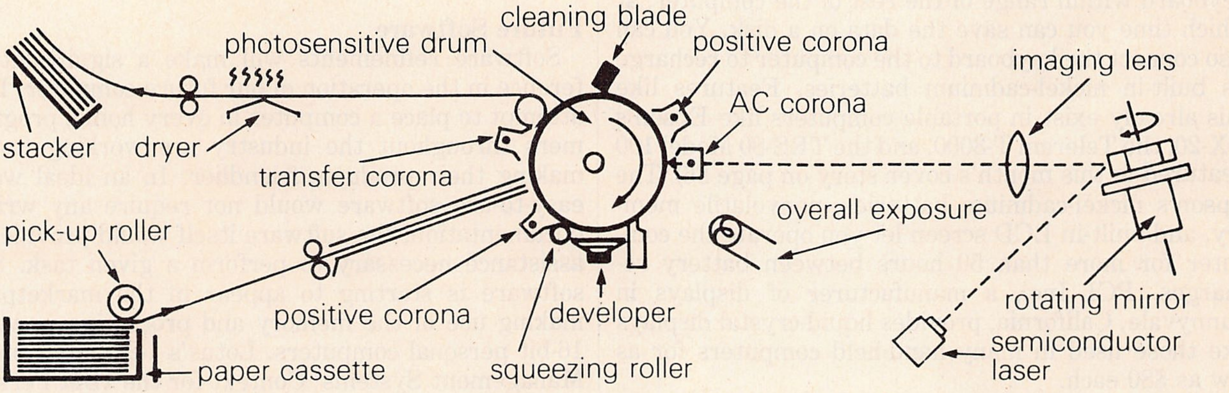
Ink-Jet and Laser Printers

Ink-jet and laser technology will provide high-quality text and graphics



The Olivetti JP-101 ink-jet printer (shown below, right) can print 50 lines of text per minute and offers features such as full graphics capability, bidirectional printing, an international character set, and print quality surpassing that of most dot-matrix printers.

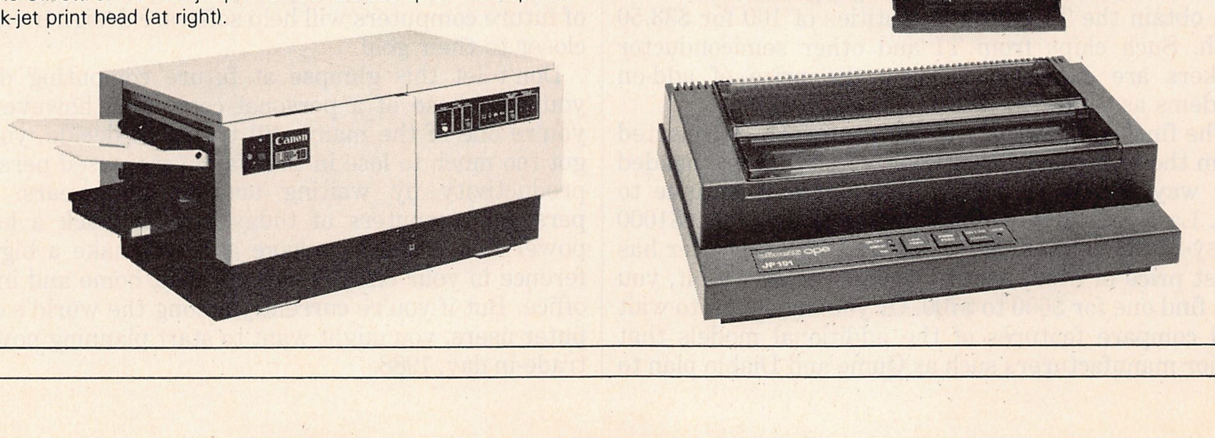
Laser printers, like Canon's LBP-10 (shown below, left), offer versatility unmatched by conventional printers. Laser printers supply letter-quality text and detailed graphics and can offer as many styles of type as the computer's software can support. Currently, such printers are expensive (the Canon unit costs $6250 in lots of 10), but these prices are significantly less than those of earlier laser printers. Within 10 years, low-end laser printers may rival today's better daisy-wheel printers in cost.


cleaning blade
photosensitive drum
positive corona
imaging lens
AC corona
stacker
dryer
transfer corona
overall exposure
pick-up roller
positive corona
developer
rotating mirror
semiconductor laser
paper cassette
squeezing roller

The illustration above shows the inner workings of a laser printer. The printer's design is similar to that of an office copier, with a laser beam replacing the copier's scanning lamp. The laser beam creates an electrically charged image on a photosensitive drum. The charged image attracts an ink-like developer that is transferred to the paper, creating text and graphics like those shown at top.

Canon's LBP-10 laser printer (below).

The Olivetti JP-101 ink-jet printer with a close-up of the disposable ink-jet print head (at right).


Canon
LBP-10
olivetti
JP101

design from the cordless telephone: it operates from any location within 50 feet of the computer (see "The Portable Computer Keyboard" on page 142). The keyboard's own 8-bit microprocessor handles keyboard input and output, without distracting the computer's central processor from more important tasks. The built-in microprocessor gives the keyboard its own "intelligence," so the keyboard can display the typed entries on its built-in liquid-crystal display (LCD) and, moreover, can operate as a stand-alone portable computer. The keyboard's 64K-byte memory lets it store a number of pages of information until you can bring the keyboard within range of the rest of the computer, at which time you can save the data on a disk. You can also connect the keyboard to the computer to recharge its built-in nickel-cadmium batteries. Features like this already exist in portable computers like Epson's HX-20, the Teleram T-3000, and the TRS-80 Model 100 (featured in this month's cover story on page 86). The Epson's nickel-cadmium batteries, nonvolatile memory, and built-in LCD screen let you operate the computer for more than 50 hours between battery recharges. PCI Inc., a manufacturer of displays in Sunnyvale, California, provides liquid-crystal displays like those used in many hand-held computers for as low as $80 each.

Virtually every firm that currently manufactures office copiers is developing lower-cost laser printers. A Japanese company may introduce one soon for about $1200.

Also built into our future computer is a low-cost telephone modem option. Similar to Texas Instruments' new "modem-in-a-chip," this one-chip unit contains all the circuitry needed to enable a computer to communicate over telephone lines. The chip can originate or answer calls and hooks up to the telephone network by direct connection or acoustic coupling. Manufacturers can obtain the TI chip in quantities of 100 for $33.50 each. Such chips from TI and other semiconductor makers are expected to drop the price of add-on modems as well.

The final complements to our computer are selected from the expanded choice of printers that are headed our way. Prices of daisy-wheel printers continue to fall. Last year saw the introduction of the under-$1000 daisy-wheel printer. Smith-Corona's TP-1 printer has a list price of $799, and if you shop around a bit, you can find one for $600 to $700. Or you may want to wait and compare features of the additional models that major manufacturers such as Qume and Diablo plan to introduce before the end of this year.

Low-cost ink-jet printers are in the final stages of development (see "Ink-Jet and Laser Printers" on page 143). Olivetti's JP-101 was recently shown at a European manufacturers' convention. The expected price in the $500 range makes the Olivetti printer competitive with popular dot-matrix printers.

Just slightly farther down the road are the laser printers that will provide quality approaching that of an offset printing press. Used in offices since the late 1970s, laser printers combine microelectronics and lasers with copier technology, resulting in a versatile printer that offers resolution untouched by current dot-matrix printers. Laser printers can produce outstanding graphics and print text in a virtually unlimited selection of computer-generated type fonts. Although the high cost of laser printers has kept them out of reach of the average personal computer user, this situation is about to change. Virtually every firm that currently manufactures office copiers is involved in developing lower-cost laser printers, and it's rumored that a Japanese company is planning to release such a printer—for around $1200—sometime soon.

Future Software

Software refinements will make a significant difference in the operation of our future computer. In an attempt to place a computer in every home, programmers throughout the industry are working toward making their products friendlier. In an ideal world, easy-to-use software would not require any written documentation; the software itself would provide any assistance necessary to perform a given task. Such software is starting to appear in the marketplace, making use of the memory and processing power of 16-bit personal computers. Lotus's 1-2-3 and Context Management Systems' Context for the IBM Personal Computer integrate word processing, numeric spreadsheets, and graphics into a single package. And for the Apple II, Savvy (see the review on page 202) from Excalibur takes user-friendliness to new levels by enabling the computer to recognize user-defined sentence patterns in plain English. The increases in memory size, storage capacity, and processing power of future computers will help software designers move closer to their goal.

Don't let this glimpse at future computing delay your purchase of a personal computer, however. If you're one of the many still trying to decide, you've got too much to lose in the way of increased personal productivity by waiting another five years. The personal computers of today already pack a lot of power into a small package and can make a big difference in your effectiveness both at home and in the office. But if you're currently among the world's computer users, you might want to start planning now for trade-in day, 1988. □

COMPACT COMPUTER 40
See Tim at noon
REET JOURNAL

TI's new Compact Computer. It takes over your work, not your desk.

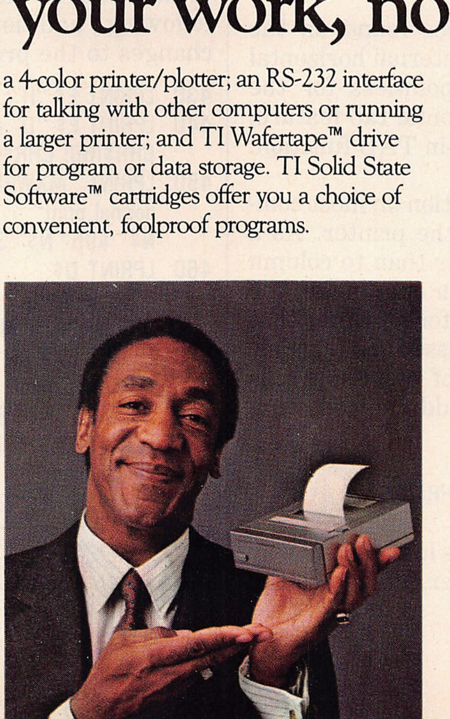
The ordinary personal computer occupies too much of the ordinary desk.

Now Texas Instruments brings you a cordless compact computer that solves the same sort of problems as the Apple™ or IBM™ personal computer. It has enough memory and power for complex problems in business and science, yet the whole thing is smaller than a magazine page.

Sophisticated software is available right now for finance, statistics, production planning, graphics—and spreadsheet and wordprocessing are just around the corner.

For most personal computer tasks, its 6K RAM and 34K ROM are ample. The system is easily, economically expanded.

The TI Compact Computer 40 has peripherals that make it even more useful: a 4-color printer/plotter; an RS-232 interface for talking with other computers or running a larger printer; and TI Wafertape™ drive for program or data storage. TI Solid State Software™ cartridges offer you a choice of convenient, foolproof programs.



Its built-in language is TI Enhanced BASIC, which allows you to write programs in everyday words. The integrated liquid crystal display shows 31 characters, which can be scrolled to show up to 80 per line. It operates on four AA alkaline batteries that give up to 200 hours of service.

The TI Compact Computer 40 offers solutions anywhere you go. Yet it retails for less than 1/3* the price of Apple™ or IBM™ personal computers. The TI Compact Computer—compact in price and size, but not in power. See it soon at your Texas Instruments retailer.

Creating useful products
and services for you.

TEXAS
INSTRUMENTS

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Programming Epson's MX-80 Printer: Part 2

How to print subscripts, underlines, tabs, and more.

by David Kater

This is the second article in our three-part series on using the original MX-80 printer (without Graftrax-80 or Gratrax Plus). We are in the process of creating a sample business letter that demonstrates how to control the printer via the BASIC language.

Those who missed the previous article (April 1983, page 126) will want to dig it out, read it, and type in the program. Veterans from last month should simply load the program back into memory, connect the printer, and get ready to discover more about the MX-80.

Horizontal Tabbing

One of the typewriter-like features found on the MX-80 printer is its ability to store internal horizontal tab stops. At first, it may seem pointless for the printer to have its own special horizontal tab feature. After all, most BASICs have a built-in TAB function. Why not use it?

Unfortunately, BASIC's TAB function on most computers affects only the screen, not the printer. As a result, many users can tab no farther than to column 40 or 64 (the number of characters in one line on the screen). This is simply not adequate for a printer that can print 80 columns (132 in compressed mode). Fortunately, Epson provides a means of bypassing this shortcoming of some computers. Add the following line to the current program:

```
400  LPRINT E$ "D"; CHR$(39);CHR$(52);CHR$(0)
```

This line establishes horizontal tabs in the same way that tab stops are set on a typewriter. Earlier in the program we set E$ equal to the Escape code (CHR$(27)). The ESC "D" tells the printer that horizontal tab values are to follow. The CHR$(39) and CHR$(52) set horizontal tab stops at columns 39 and 52. Up to 112 tabs can be set, just in case you have a healthy appetite for them. CHR$(0) is used at the end of the sequence to notify the printer that all tabs are set.

Once the tab stops are set, the ASCII code HT (9 decimal) can activate the tabbing action on any line. Make these changes and additions:

```
 30  E$=CHR$(27): N$=CHR$(9)
410  LPRINT E$ "F" E$ "G";"PRINT FEATURES";
420  LPRINT N$ "PRICE" N$ "AVAILABILITY DATE"
```

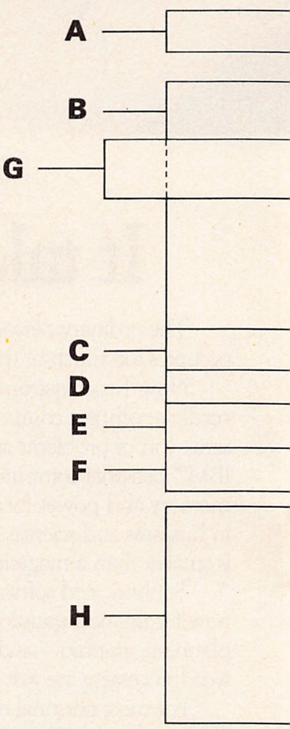
Now run the program. You should get a one-line table heading as shown in figure 1a.

In line 420, the first N$ (remember, N$ is CHR$(9) in disguise) causes a tab to the first stop, column 39. Likewise, the second N$ causes a tab to column 52. No more tabbing can be done in line 420 because we set only these two tab stops.

Note that tabbing always starts with the first tab on each new line. If we wanted to skip the first tab, we would have to send two tab codes (CHR$(9)) in succession.

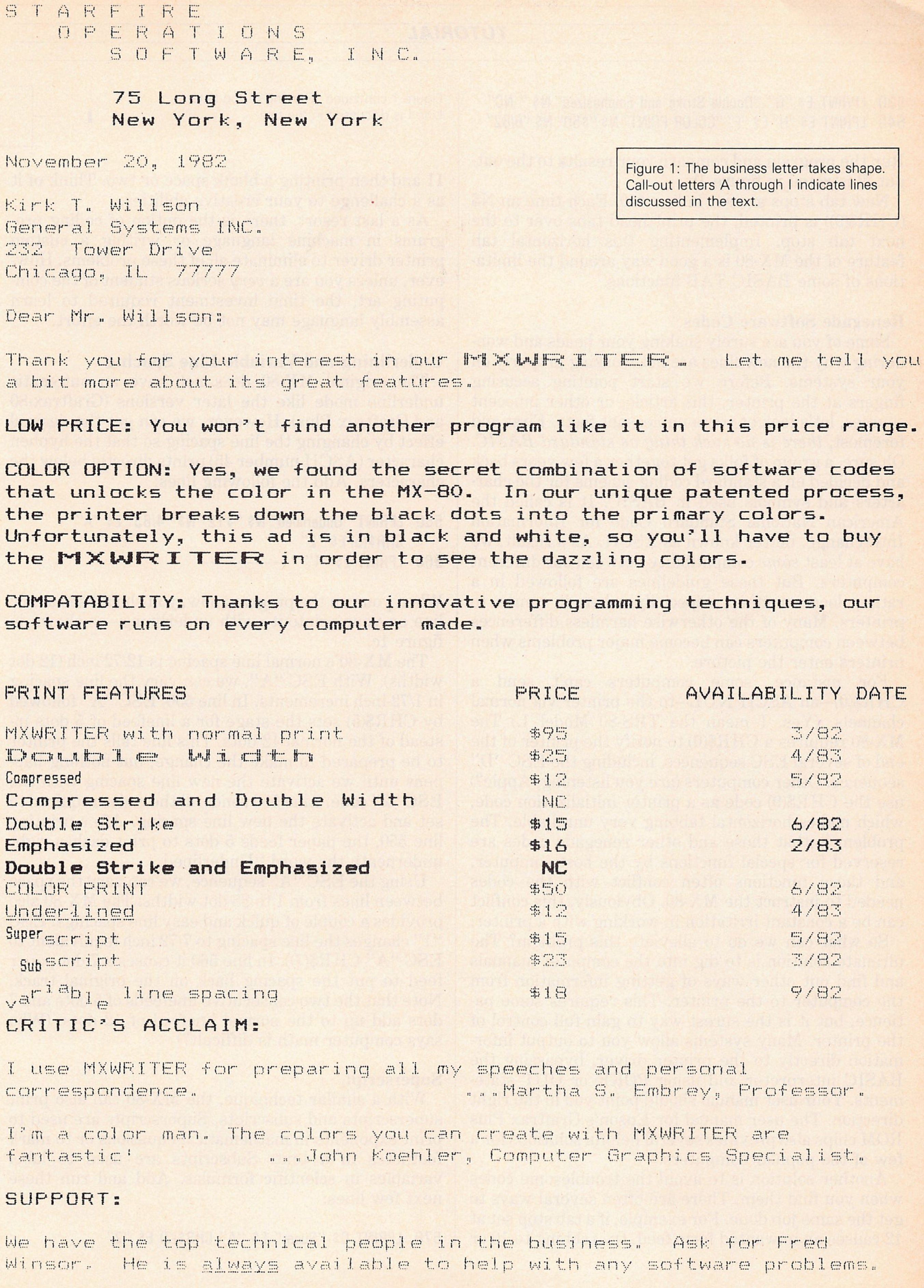
Lines 410 and 420 establish headings for the columns we wish to print. We are adding a price and availability date to each print feature. Make the following additions and changes to the program:

```
430  LPRINT E$ "H";
440  LPRINT E$ "D" CHR$(40)
     CHR$(60) CHR$(0)
450  LPRINT "MXWRITER with
     normal print"
     N$ "$95" N$ "3/82"
460  LPRINT D$
     "Double Width"
     DX$ N$ "$25" N$ "4/83"
510  LPRINT CX$ E$ "G"
     "Double Strike"
     N$ "$15" N$ "6/82"
520  LPRINT E$ "H" E$ "E"
     "Emphasized"
     N$ "$16" N$ "2/83"
```



David Kater is a freelance writer with a special interest in printers and graphics. His most recently published book is *TRS-80 Graphics for the Model I and Model III* (Radio Shack #62-2087).

Figure 1: The business letter takes shape. Call-out letters A through I indicate lines discussed in the text.



S T A R F I R E
O P E R A T I O N S
S O F T W A R E, I N C.

75 Long Street
New York, New York

November 20, 1982

Kirk T. Willson
General Systems INC.
232 Tower Drive
Chicago, IL 77777

Dear Mr. Willson:

Thank you for your interest in our **MXWRITER**. Let me tell you a bit more about its great features.

LOW PRICE: You won't find another program like it in this price range.

COLOR OPTION: Yes, we found the secret combination of software codes that unlocks the color in the MX-80. In our unique patented process, the printer breaks down the black dots into the primary colors. Unfortunately, this ad is in black and white, so you'll have to buy the MXWRITER in order to see the dazzling colors.

COMPATABILITY: Thanks to our innovative programming techniques, our software runs on every computer made.

PRINT FEATURES	PRICE	AVAILABILITY DATE
MXWRITER with normal print	$95	3/82
Double Width	$25	4/83
Compressed	$12	5/82
Compressed and Double Width	NC	NC
Double Strike	$15	6/82
Emphasized	$16	2/83
Double Strike and Emphasized	**NC**	
COLOR PRINT	$50	6/82
Underlined	$12	4/83
Superscript	$15	5/82
Subscript	$23	3/82
variable line spacing	$18	9/82

CRITIC'S ACCLAIM:

I use MXWRITER for preparing all my speeches and personal correspondence. ...Martha S. Embrey, Professor.

I'm a color man. The colors you can create with MXWRITER are fantastic' ...John Koehler, Computer Graphics Specialist.

SUPPORT:

We have the top technical people in the business. Ask for Fred Winsor. He is always available to help with any software problems.

```
530 LPRINT E$ "G" "Double Strike and Emphasized" N$ " NC"
540 LPRINT E$ "H" E$ "F" "COLOR PRINT" N$ "$50" N$ "6/82"
```

Run the program and compare your results to the output illustrated in figure 1b.

New tab stops are set in line 440. Each time an N$ (CHR$(9)) is printed, the print head tabs over to the next tab stop. Implementing this horizontal tab feature of the MX-80 is a good way around the limitations of some BASIC TAB functions.

Renegade Software Codes

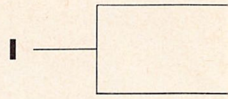
Some of you are surely shaking your heads and wondering why the new lines are not working properly on your systems. Before we start pointing accusing fingers at the printer, this article, or other innocent sources, let's look at some unpleasant facts. First and foremost, *there is no such thing as standard BASIC.* Oh sure, a group of folks got together a few years back and decided on a standard coding scheme for the characters and symbols used in BASIC. It is called the American National Standard Code for Information Interchange, better known as ASCII. As a result, we have at least *some* compatibility between our different computers. But these guidelines are followed in a rather loose manner, especially when it comes to printers. Many of the otherwise harmless differences between computers can become major problems when printers enter the picture.

For instance, some computers can't send a CHR$(0)—an ASCII NUL—to the printer via normal channels. (Yes, I mean the TRS-80 Model I.) The MX-80 requires a CHR$(0) to notify the printer of the end of several ESC sequences, including the ESC "D" sequence. Other computers (are you listening, Apple?) use the CHR$(9) code as a printer initialization code, which makes horizontal tabbing very unreliable. The problem is that these and other renegade codes are reserved for special functions by the host computer, and these functions often conflict with the codes needed to instruct the MX-80. Obviously, this conflict can be a constant irritation in working with a printer.

So what can we do to alleviate this problem? The ultimate solution is to dig into the computer manuals and find out other ways of getting information from the computer to the printer. This requires some patience, but it is the surest way to gain full control of the printer. Many systems allow you to output information directly to the printer driver, bypassing the BASIC interpreter and using POKE or OUT statements. Your user manual should point you in the right direction. The user manual for Epson's Graftrax Plus ROM chips also provides several helpful solutions for a few of the popular computers.

Another solution is to avoid the troublesome codes when you find them. There are often several ways to get the same job done. For example, if a tab stop set at 12 causes an unwanted form feed, try tabbing to 10 or 11 and then printing a blank space or two. Think of it as a challenge to your creative abilities.

Figure 1 continued: The end of the letter. Line I is discussed in the text.



As a last resort, there is the option of coding programs in machine language or writing a custom printer driver to eliminate all of these problems. However, unless you are a *very* serious student of the computing art, the time investment required to learn assembly language may not be worth the effort.

Underlining and Variable Line Spacing

The original MX-80 does not have an automatic underline mode like the later versions (Graftrax-80 and Graftrax Plus). However, we can get the desired effect by changing the line spacing so that the hyphen character (ASCII number 45) prints directly below the characters. Add the following lines:

```
550 LPRINT "Underlined" N$ "$12" N$ "4/83" E$ "A"
    CHR$(5) E$ "2"
560 LPRINT E$ "1" "----------"
```

When you run the program now, you should see a new line on your printout—with underlining—as shown in figure 1c.

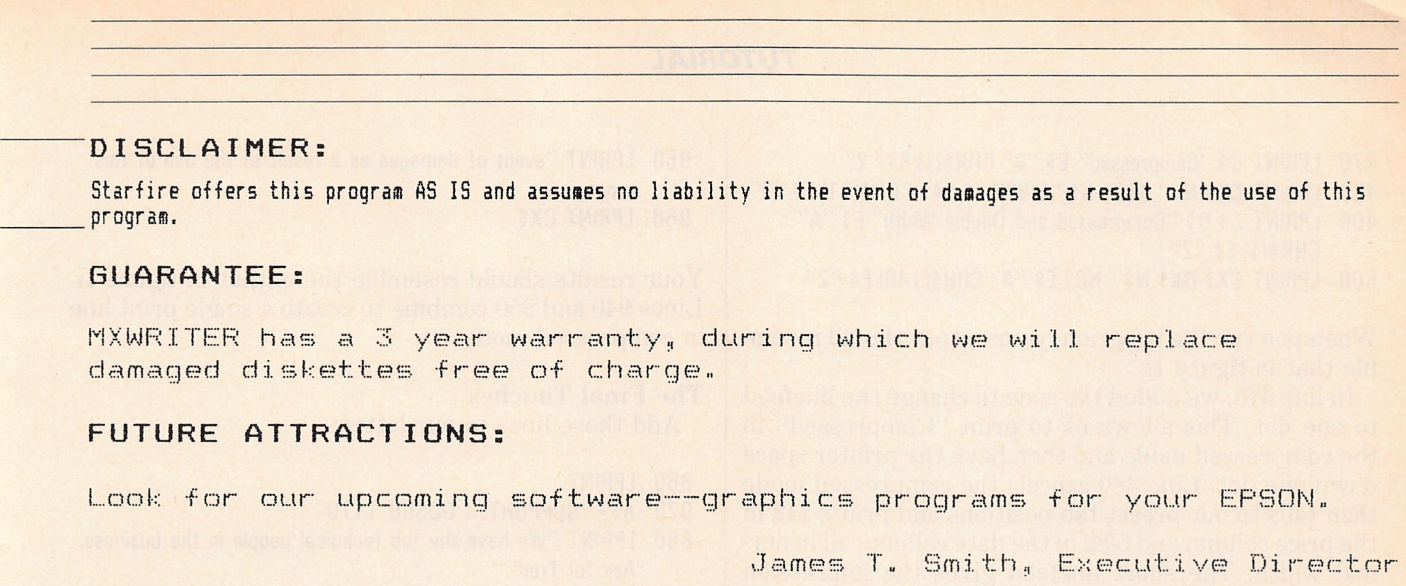
The MX-80's normal line spacing is 12/72 inch (12 dot widths). With ESC "A", we can vary the line spacing in 1/72-inch increments. In line 550, ESC "A" followed by CHR$(5) sets the stage for a linefeed of 5 dots instead of the normal 12 dots. This line tells the printer to be prepared to make the change, but nothing happens until we activate the new line spacing with the ESC "2" code. Line 550 sends all the codes required to set and activate the new line spacing. After printing line 550, the paper feeds 5 dots to print dashes right underneath the word "Underlined."

Using the ESC "A" sequence, we can vary the space between lines from 1 to 85 dot widths. The MX-80 also provides a couple of quick and easy line spacings. ESC "1" changes the line spacing to 7/72 inch (equivalent to ESC "A" CHR$(7)). In line 560 it causes a 7-dot paper feed to put the spacing back on the original track. Note that the two consecutive linefeeds of 5 dots and 7 dots add up to the normal linefeed of 12 dots. (Who says computer math is difficult?)

Superscript

With a similar technique, the MX-80 can also print superscripts and subscripts. Superscripts are used to print exponents in mathematical equations or to mark footnotes in a text. Subscripts are used to label variables in scientific formulas. Add and run these next few lines:

```
570 LPRINT C$ "Super" E$ "A" CHR$(3) E$ "2"
```



```
DISCLAIMER:
Starfire offers this program AS IS and assumes no liability in the event of damages as a result of the use of this
program.

GUARANTEE:

MXWRITER has a 3 year warranty, during which we will replace
damaged diskettes free of charge.

FUTURE ATTRACTIONS:

Look for our upcoming software--graphics programs for your EPSON.

                                   James T. Smith, Executive Director
```

```
580 LPRINT TAB(3) CX$ "script" N$ "$15" N$ "5/82" E$ "A"
    CHR$(140) E$ "2"
```

Compare your results to the output in figure 1d.

Easy, isn't it? By using a few simple tricks like changing to compressed mode and varying the linefeed, we can come up with effects that look pretty good. The codes to enter and exit compressed mode are stored in C$ and CX$ respectively.

Line 570 changes the line spacing to 3 dots, and the end of line 580 sets it back to 12, the normal setting. (We use 140 because 12 is another one of those rebel codes. Sometimes adding 128 to a problem code enables it to pass through the BASIC interpreter unmolested.)

Subscript

We can also print subscripts by varying the line spacing and optionally using compressed mode. Add these lines:

```
590 LPRINT TAB(3) "script" N$ "$23" N$ "3/82" E$ "A"
    CHR$(3) E$ "2"
600 LPRINT C$ TAB(3) "Sub" E$ "A" CHR$(140) E$ "2":
    LPRINT CX$;
```

Run the lines and compare your output to figure 1e. Again, we convert the line spacing back to the standard 12 dots when finished.

More Variable Line Spacing

We've seen how to underline and how to create superscripts and subscripts by changing the line spacing as needed. Add these next four lines, which follow along in the same tradition:

```
610 LPRINT TAB(4) "ia" E$ "A" CHR$(3) E$ "2"
620 LPRINT TAB(2) "r" TAB(5) "b" "  line spacing" N$ "$18" N$
    "9/82"
630 LPRINT TAB(1) "a" TAB(6) "l"
640 LPRINT "v" TAB(7) "e" E$ "A" CHR$(140) E$ "2"
```

Run the lines, see if your output matches that illustrated in figure 1f, and try to understand how these effects were achieved.

Mixing Compressed and Normal Print

Let's see what happens when we add a price and date to our compressed features. Run the program after making these additions and changes:

```
470 LPRINT C$ "Compressed";
480 LPRINT CX$ N$ "$12" N$ "5/82"
490 LPRINT C$ D$ "Compressed and Double Width";
500 LPRINT CX$ N$ " NC"
```

Looks like we have a few problems on our hands. First, what happened to the compressed print we were promised in lines 470 and 490? (Recall that C$ turns on compressed mode and CX$ turns it off.) It turns out that we can't combine compressed print with normal print on the *same print line.* If several print-width codes are sent to the printer, the last one determines the width of the *entire* line. Lines 470 and 480 illustrate this point. The printer receives a C$ followed closely by a CX$. The last code sent (CX$) takes charge, so the entire line is printed in normal width. That is a limitation that we simply have to learn to live with.

Compressed Print vs. Horizontal Tabs

Another problem would arise if we simply eliminated the CX$ codes. Our horizontal tabs are set up for normal-width characters. If the lines were printed in compressed width, the tabs would not line up at all with the other print features. So the challenge to us is to print the two lines in compressed width while still somehow using the current tab settings.

Variable line spacing comes to the rescue once again. The printer won't let us mix compressed and normal print, but with a little trickery we can make it look as if they are on the same line. Change these lines:

```
470 LPRINT C$ "Compressed" E$ "A" CHR$(1) E$ "2"
480 LPRINT CX$ N$ "$12" N$ "5/82" E$ "A" CHR$(11) E$ "2"
490 LPRINT C$ D$ "Compressed and Double Width" E$ "A"
    CHR$(1) E$ "2"
500 LPRINT CX$ DX$ N$" NC" E$ "A" CHR$(140) E$ "2"
```

When you run the program, your output should resemble that in figure 1g.

In line 470, we added the code to change the linefeed to one dot. This allows us to print "Compressed" in the compressed mode and then have the printer space down one dot. Line 480 cancels the compressed mode then tabs to our preset tab positions and prints $12 in the price column and 5/82 in the date column, all in normal width. The short linefeed gives the impression that both are printed on the same line. The same technique is used in lines 490 and 500. At the end of line 500 we return the printer's line spacing back to the normal 12 dots.

A Helpful Subroutine

The next few lines provide us with a subroutine that will save us some typing during the rest of the program.

```
1170 LPRINT C$D$;A$
1180 LPRINT CX$
1190 RETURN
```

This routine is used to print a string (stored in A$) in both compressed and double-width modes. The following lines add some user testimonials and show off our subroutine:

```
800 A$="CRITICS' ACCLAIM:": GOSUB 1170
810 LPRINT "I use MXWRITER for preparing all my speeches and
    personal"
820 LPRINT "correspondence. ...Martha S. Embrey, Professor."
830 LPRINT
840 LPRINT "I'm a color man; the colors you can create with
    MXWRITER are"
850 LPRINT "fantastic! ...John Koehler, Computer Graphics
    Specialist."
```

Run the program and compare your results with figure 1h. Line 800 uses our subroutine, which causes the string stored in A$ (i.e., "CRITICS' ACCLAIM:") to be printed in the compressed and double-width modes.

The Fine Print

Compressed mode is ideal for that infamous fine print that no one likes to read. Add and run these lines:

```
930 A$="DISCLAIMER:": GOSUB 1170
940 LPRINT C$ "Starfire offers this program AS IS and assumes no
    liability in the ";
950 LPRINT "event of damages as a result of the use of this
    program."
960 LPRINT CX$
```

Your results should resemble the output in figure 1i. Lines 940 and 950 combine to create a single print line in compressed mode.

The Final Touches

Add these lines to our letter:

```
 860 LPRINT
 870 A$="SUPPORT:": GOSUB 1170
 880 LPRINT "We have the top technical people in the business.
     Ask for Fred"
 890 LPRINT E$"A" CHR$(5) E$"2";
 900 LPRINT "Winsor. He is always available to help with any
     software problems.";
 910 LPRINT TAB(15) E$"1" "------"
 920 LPRINT E$"A"CHR$(140)E$"2"
 925 FOR I=1 TO 7: LPRINT: NEXT I
 960 LPRINT
 970 A$="GUARANTEE:": GOSUB 1170
 980 LPRINT "MXWRITER has a 3 year warranty, during which we
     will replace"
 990 LPRINT "damaged diskettes free of charge."
1000 LPRINT
1010 A$="FUTURE ATTRACTIONS:": GOSUB 1170
1020 LPRINT "Look for our upcoming software—graphics programs
     for your EPSON."
1030 LPRINT :LPRINT N$;"James T. Smith, Executive Director":
     LPRINT
1160 END
```

Figure 1 shows the entire letter. For your reference, the complete program is printed at the end of the article (see page 152).

The latest additions help to fill in the letter. Note that lines 890, 910, and 920 temporarily change the normal line spacing so that we can underline the word "always." We start out in line 890 with a line spacing of 5 dots. In line 910, we set the line spacing to 7 dots, then space over 15 and print the dashes under "always." Line 920 sets the line spacing back to normal. (Note: 140 is used instead of 12 to avoid an unwanted formfeed.)

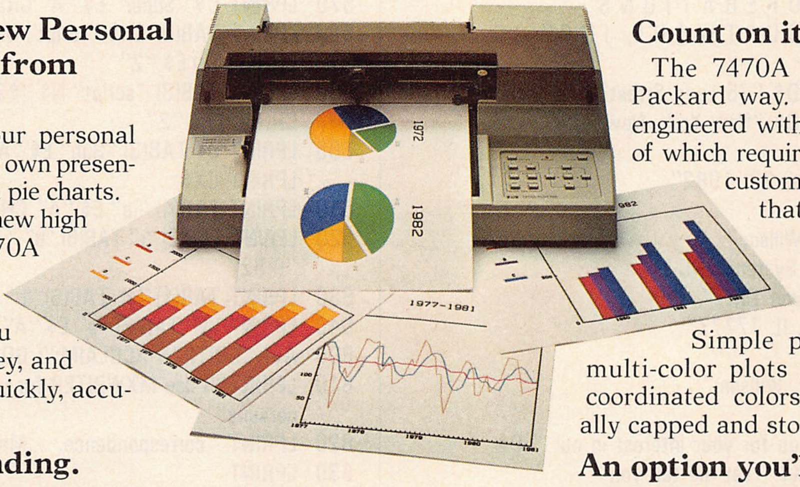
For printouts of more than one page, we should avoid that paper perforation. Sending a formfeed code (12 decimal) is one way to handle the problem. We choose instead to insert a temporary line (925) to force several linefeeds. This line will be removed in the last article.

Next Time

In the final article of this series, we'll add an order blank and highlight it with graphics characters. We will also use block graphics characters to create a logo and some oversized letters to add some visual clout.

Plot your next meeting yourself.

Read how 2 pens can become your best presentation tools.



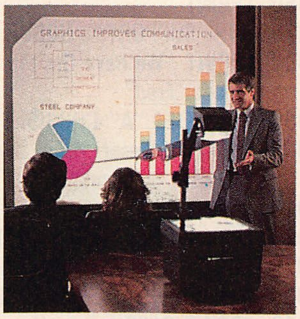
Introducing the New Personal Computer Plotter from Hewlett-Packard.

Now you can use your personal computer to generate your own presentation charts, graphs, and pie charts. How? Simply add on the new high quality, low cost HP 7470A Personal Computer Plotter.

The 7470A helps you save time and save money, and lets you communicate quickly, accurately and *effectively.*

Quicker understanding.

Data, when visualized graphically, becomes information fast. Charts and bar graphs can make any presentation clearer and more readily understood. But asking your staff to produce the graphics manually for your next presentation doesn't ensure accuracy or artistic talent. And going to outside graphics suppliers can be costly. Combined with your personal computer, the new HP 7470A plotter does the communicating for you. Quickly. Logically. And with off-the-shelf software available from most HP dealers.



Fast and pretty.

The 7470A gives you high plotting speed with excellent line quality...faster than any competitive small plotter. On top of all that, it comes in an attractive design package that looks nice on your desk. And it does it for only $1,575. (U.S.A. domestic suggested retail price.)

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Mail the coupon below and we'll send you—absolutely free—a sample plot, a more detailed brochure, and a sample overhead transparency.

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When performance must be measured by results

HEWLETT PACKARD

Seeing is believing. Send me a sample plot, an overhead transparency, and more detailed information.

Name ______________________ Title ______________________

Company ______________________

Address ______________________

City, State & Zip ______________________

Phone Number (   ) ______________________

My computer is ______________________

Send to: Hewlett-Packard, 16399 W. Bernardo Drive, San Diego, CA 92127—Attn: Nancy Carter

11203 PC5

Here's the complete listing for creating the letter in its present form:

```
  10 C$=CHR$(15):CX$=CHR$(18)
  20 D$=CHR$(14):DX$=CHR$(20)
  30 E$=CHR$(27):N$=CHR$(9)
  40 Z$=CHR$(42):B$=CHR$(42)
  50 LPRINT "S T A R F I R E"
  60 LPRINT TAB(4) "O P E R A T I O N S"
  70 LPRINT TAB(8) "S O F T W A R E,  I N C."
 130 LPRINT C$
 140 LPRINT TAB(14) D$ "75 Long Street"
 150 LPRINT TAB(14) D$ "New York, New York"
 160 LPRINT CX$
 170 LPRINT "November 20, 1982"
 180 LPRINT
 190 LPRINT "Kirk T. Willson"
 200 LPRINT "General Systems INC."
 210 LPRINT "232 Tower Drive"
 220 LPRINT "Chicago, IL 77777"
 230 LPRINT
 240 LPRINT "Dear Mr. Willson:"
 250 LPRINT
 260 LPRINT "Thank you for your interest in our " D$
     "MXWRITER. "DX$ " Let me tell you"
 270 LPRINT "a bit more about its great features."
 280 LPRINT E$ "E"
 290 LPRINT "LOW PRICE: You won't find another program like it
     in this price range."
 300 LPRINT
 310 LPRINT "COLOR OPTION: Yes, we found the secret
     combination of software codes"
 320 LPRINT "that unlocks the color in the MX-80. In our unique
     patented process,"
 330 LPRINT "the printer breaks down the black dots into the
     primary colors."
 340 LPRINT "Unfortunately, this ad is in black and white, so you'll
     have to buy"
 350 LPRINT "the " D$ "MXWRITER" DX$ " in order to see the
     dazzling colors."
 360 LPRINT
 370 LPRINT "COMPATIBILITY: Thanks to our innovative
     programming techniques, our software"
 380 LPRINT "runs on every computer made. "
 390 LPRINT
 400 LPRINT E$ "D" CHR$(39) CHR$(52) CHR$(0)
 410 LPRINT E$ "F" E$ "G" "PRINT FEATURES";
 420 LPRINT N$ "PRICE" N$ "AVAILABILITY DATE"
 430 LPRINT E$ "H";
 440 LPRINT E$ "D" CHR$(40) CHR$(60) CHR$(0)
 450 LPRINT "MXWRITER with normal print"N$"$95"N$"3/82"
 460 LPRINT D$ "Double Width" DX$ N$ "$25" N$ "4/83"
 470 LPRINT C$ "Compressed" E$ "A" CHR$(1) E$ "2"
 480 LPRINT CX$ N$ "$12" N$ "5/82" E$ "A"
     CHR$(11) E$ "2"
 490 LPRINT C$ D$ "Compressed and Double Width" E$ "A"
     CHR$(1) E$ "2"
 500 LPRINT CX$ DX$ N$ " NC" E$ "A" CHR$(140) E$ "2"
 510 LPRINT CX$ E$ "G" "Double Strike" N$ "$15" N$ "6/82"
 520 LPRINT E$ "H" E$ "E" "Emphasized" N$ "$16" N$ "2/83"
 530 LPRINT E$ "G" "Double Strike and Emphasized" N$ " NC"
 540 LPRINT E$ "H" E$ "F" "COLOR PRINT" N$ "$50" N$
     "6/82"
 550 LPRINT "Underlined" N$ "$12" N$ "4/83" E$ "A" CHR$(5)
     E$ "2"
 560 LPRINT E$ "1" "----------"
 570 LPRINT C$ "Super" E$ "A" CHR$(3) E$ "2"
 580 LPRINT TAB(3) CX$ "script" N$ "$15" N$ "5/82" E$ "A"
     CHR$(140) E$ "2"
 590 LPRINT TAB(3) "script" N$ "$23" N$ "3/82" E$ "A"
     CHR$(3) E$ "2"
 600 LPRINT C$ TAB(3) "Sub" E$ "A" CHR$(140) E$ "2":
     LPRINT CX$;
 610 LPRINT TAB(4) "ia" E$ "A" CHR$(3) E$ "2"
 620 LPRINT TAB(2) "r" TAB(5) "b" "  line spacing" N$ "$18" N$
     "9/82"
 630 LPRINT TAB(1) "a" TAB(6) "l"
 640 LPRINT "v" TAB(7) "e" E$ "A" CHR$(140) E$ "2"
 800 A$="CRITIC'S ACCLAIM:": GOSUB 1170
 810 LPRINT "I use MXWRITER for preparing all my speeches and
     personal"
 820 LPRINT "correspondence. ...Martha S. Embrey, Professor."
 830 LPRINT
 840 LPRINT "I'm a color man. The colors you can create with
     MXWRITER are"
 850 LPRINT "fantastic!  ...John Koehler, Computer Graphics Specialist."
 860 LPRINT
 870 A$="SUPPORT:": GOSUB 1170
 880 LPRINT "We have the top technical people in the business.
     Ask for Fred"
 890 LPRINT E$ "A" CHR$(5) E$ "2";
 900 LPRINT "Winsor. He is always available to help with any
     software problems."
 910 LPRINT TAB(15) E$ "1" "------"
 920 LPRINT E$ "A" CHR$(140) E$ "2"
 925 FOR I=1 TO 7: LPRINT: NEXT I
 930 A$="DISCLAIMER:": GOSUB 1170
 940 LPRINT C$"Starfire offers this program AS IS and assumes
     no liability in the ";
 950 LPRINT "event of damages as a result of the use of this
     program."
 960 LPRINT
 970 A$="GUARANTEE:": GOSUB 1170
 980 LPRINT "MXWRITER has a 3 year warranty, during which we
     will replace"
 990 LPRINT "damaged diskettes free of charge."
1000 LPRINT
1010 A$="FUTURE ATTRACTIONS:": GOSUB 1170
1020 LPRINT "Look for our upcoming software—graphics programs
     for your EPSON."
1030 LPRINT: LPRINT N$;"James T. Smith, Executive
     Director":LPRINT
1160 END
1170 LPRINT C$ D$ A$
1180 LPRINT CX$
1190 RETURN
```

□

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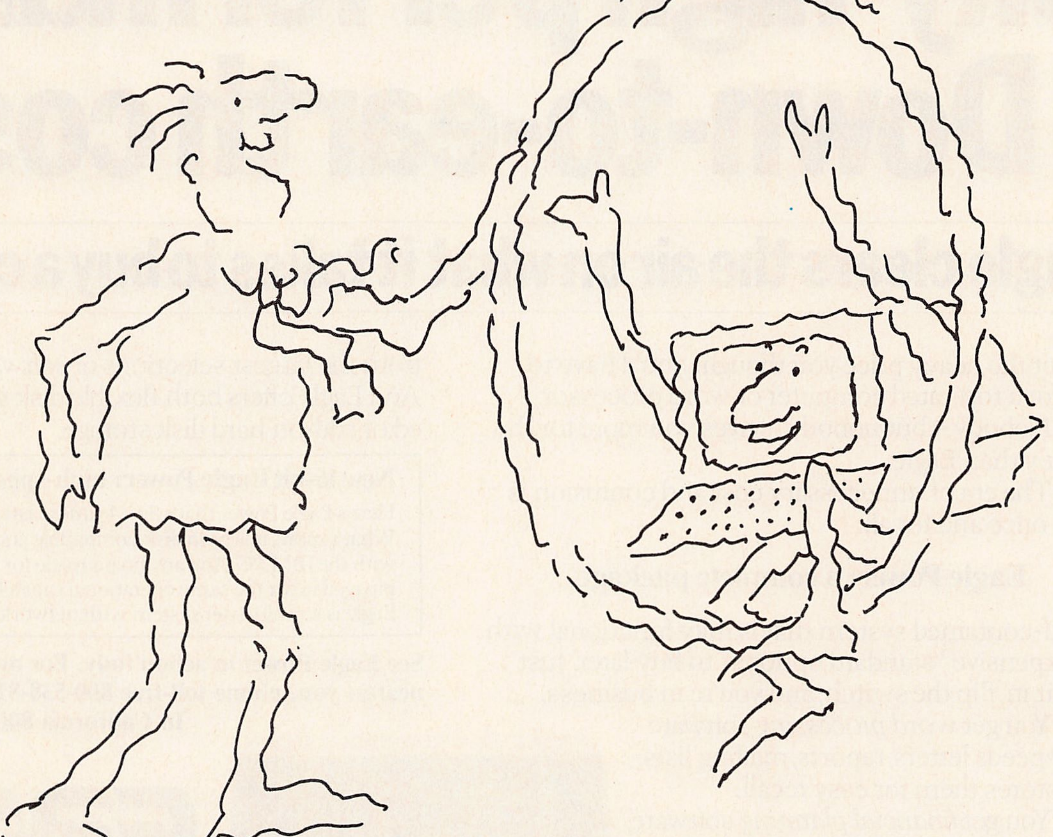
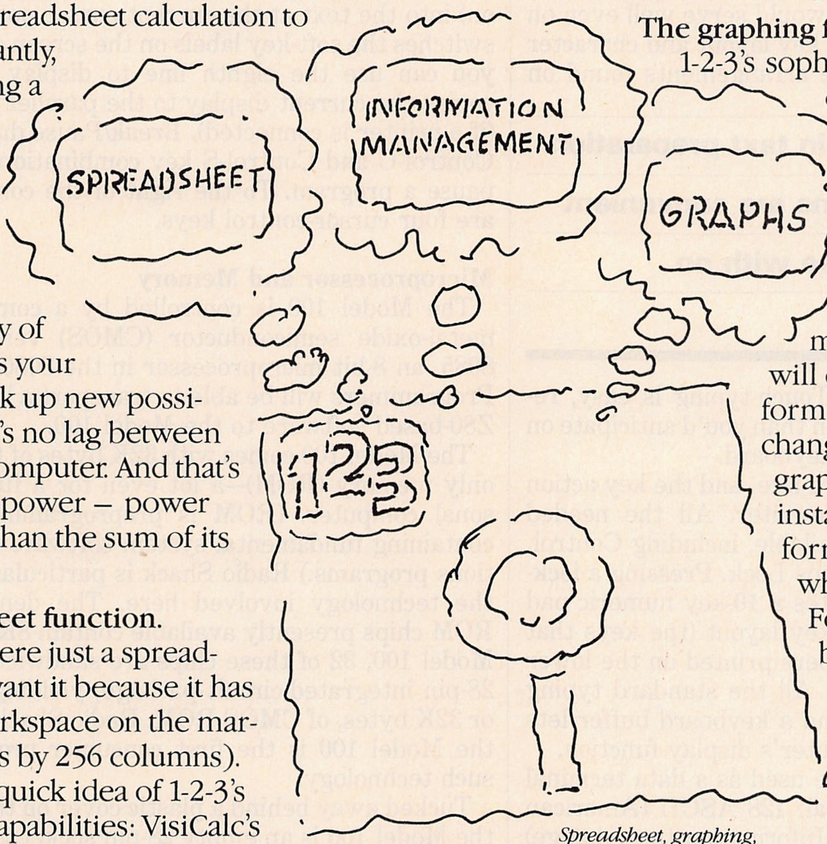
Circle 126 on inquiry card.

INTRODUCING 1-2-3.™ IT'LL HAVE YOUR IBM/PC JUMPING THROUGH HOOPS.



Meet 1-2-3 – the remarkable new software package that puts more raw power at your fingertips than anything yet created for the IBM PC. 1-2-3 actually combines information management, spreadsheet, and graphing in one program that can perform all three functions interchangeably and instantly at the touch of a key. That's power.

To explain: since 1-2-3's information management, spreadsheet and graphing functions reside in memory simultaneously, you can go from retrieval to spreadsheet calculation to graphing instantly, just by pressing a few keys. So now you can experiment and recalculate and look at data in an endless variety of ways. As fast as your mind can think up new possibilities. There's no lag between you and the computer. And that's a new kind of power – power that's greater than the sum of its programs.



Spreadsheet, graphing, information management all-in-one.

The spreadsheet function.

If 1-2-3 were just a spreadsheet, you'd want it because it has the largest workspace on the market (2048 rows by 256 columns). To give you a quick idea of 1-2-3's spreadsheet capabilities: VisiCalc's spreadsheet for the IBM PC offers 15 arithmetic, logical and relational operators, 28 functions and 32 spreadsheet-related commands. 1-2-3 has 15 operators, 41 functions and 66 commands. And if you include data base and graphing commands, it actually has 110!

In addition, 1-2-3 is up to 50 times as fast as established spreadsheets. With all the features you've ever seen on spreadsheets. 1-2-3 also gives you the capability to develop customized applications (with 26 macro keys) and lets you perform repetitive tasks automatically with one keystroke. If 1-2-3 were just a spreadsheet, it would be a very powerful tool. But it's much, much more.

The information management function.

Add to 1-2-3's spreadsheet a selective information management function, and the power curve rises at an awesome rate. Particularly since 1-2-3's information management capability reads files from other programs such as WordStar, VisiCalc and dBase II. So you can accumulate information on a limitless variety of topics and extract all or pieces of it for instant spreadsheet analysis. Unheard of before. Specific 1-2-3 information management features include sorting with primary and secondary keys. Retrieval using up to 32 criteria. 1-2-3 performs statistical functions such as mean, count, standard deviation and variance. It can produce histograms on part or all of the data base. 1-2-3 also allows for the maintenance of multiple data bases and multiple criteria.

The graphing function.

1-2-3's sophisticated graphing commands enable you to create graphs of up to six variables using information already on the spreadsheet. And have it on screen in less than two seconds! Once you've made a graph, three keystrokes will display it in a different form. If data on the spreadsheet changes, you can display a revised graph with one keystroke. This instant relationship of one format to another opens up a whole new application area.

For the first time graphics can be used as a "what if" thinking tool!

To fully understand just how much power 1-2-3 adds to the personal computer you'll want to go to your nearby 1-2-3 dealer for a full demonstration. For his name and address (and more information if you want it) call 1-800-343-5414.

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CONTINUED FROM PAGE 89

Keyboard

You expect some compromises on the keyboard of a computer that fits in a briefcase. One of the most surprising and laudable qualities of the Model 100, though, is that its keyboard would serve well even on a desktop computer. In fact, key layout and character capacity are superior to the arrangements found on many personal computers. Touch-typing is easy, requiring far less familiarization than you'd anticipate on first encounter with a new keyboard.

All the steps involved in text preparation and telecommunications are convenient and easy even for those with no computer experience.

The keyboard is of standard size, and the key action is that of an ordinary typewriter. All the needed special function keys are available, including Control, Escape, Tab, Delete, and Caps Lock. Pressing a locking key labeled Num activates a 10-key numeric pad embedded in the standard key layout (the keys that make up the pad have numbers printed on the lower right corners of their tops). All the standard typing keys repeat if held down, and a keyboard buffer lets you type ahead of the computer's display function.

Any computer that is to be used as a data terminal should be able to generate all 128 ASCII (American National Standard Code for Information Interchange) characters, but not all personal computers can. The Model 100 is able to, even down to the ASCII NUL (binary 0). In fact, the keyboard can generate 256 distinct codes (0 through 255). As a result, you can type in all of the foreign-language, graphics, and miscellaneous characters that can be displayed—a very useful feature for Model 100 programmers.

Lined up in a row above the main keyboard are 16 additional keys grouped in clusters of four. The eight keys to the left, labeled F1 through F8, serve as programmable function keys. Depending on the applications program, they may activate frequently used operations, change modes, or otherwise simplify the use of the keyboard.

Eight "soft-key" labels can be displayed on the bottom line of the LCD to specify the current functions of keys F1 through F8 (see photo on page 86). Ideally, the function keys should be directly below the soft-key labels they correspond to. Mechanical design considerations made this impossible, however, and the keys are below and off to the side of the LCD. To clarify the key-to-label correspondence, boxes numbered 1 though 8 are printed on the LCD's frame directly below the corresponding labels.

To the right of the programmable function keys, you'll find Paste, Label, Print, and Break/Pause, four command keys whose functions remain consistent in all applications. Paste is a very useful key that inserts the contents of the cut-and-paste buffer (detailed later on) into the text at the current cursor position. Label switches the soft-key labels on the screen on and off so you can use the eighth line to display data. Print copies the current display to the parallel printer port (if a printer is connected). Break/Pause duplicates the Control-C and Control-S key combinations to stop or pause a program. To the right of the command keys are four cursor-control keys.

Microprocessor and Memory

The Model 100 is controlled by a complementary metal-oxide semiconductor (CMOS) version of the 8085, an 8-bit microprocessor in the 8080/Z80 family. Programmers will be able to transport a large body of Z80-based software to the Model 100.

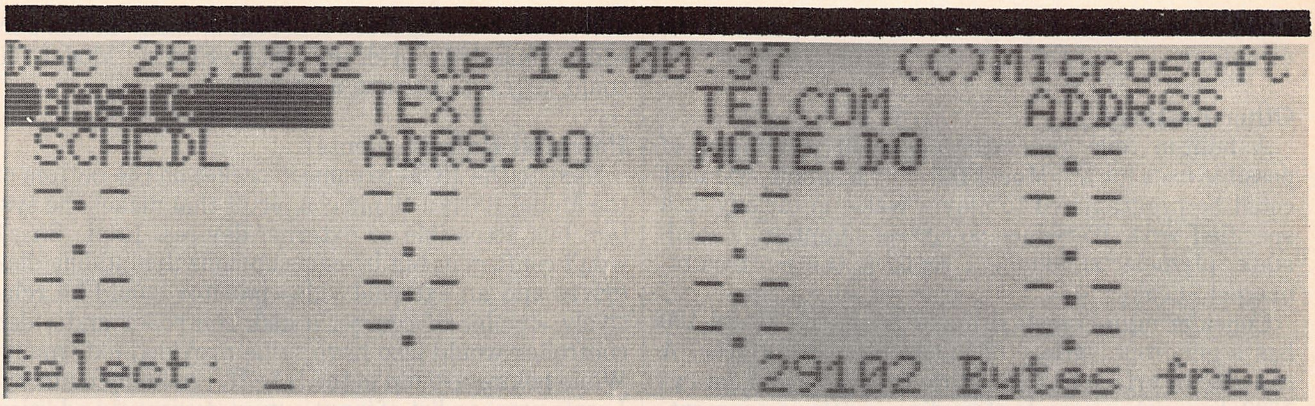
The Model 100 comes with 32K bytes of CMOS read-only memory (ROM)—a lot even for a full-sized personal computer. (ROM is preprogrammed memory containing fundamental system software and applications programs.) Radio Shack is particularly proud of the technology involved here. The densest CMOS ROM chips presently available contain 8K bits. In the Model 100, 32 of these chips are sandwiched into one 28-pin integrated-circuit package, yielding 256K bits, or 32K bytes, of CMOS ROM. Radio Shack claims that the Model 100 is the first consumer product to use such technology.

Tucked away behind a plastic cover on the bottom of the Model 100 is an empty 28-pin socket (see photo on page 89). An additional 32K bytes of ROM can be plugged in here. Because the extra ROM shares the same memory space as the first ROM, the two ROMs are not available to the system simultaneously. Instead, they are switched in and out by software. Although Radio Shack won't confirm it, this capability seems to promise application ROMs for functions such as full-fledged word processing, financial modeling, real-estate calculations, and so forth.

At $799, the Model 100 includes 8K bytes of RAM (random-access memory—used to store your programs and data). A $999 package gives you 24K bytes of RAM. More RAM can be added to either version in 8K-byte units for $120 each, plus installation. The Model 100 can be equipped with a maximum of 32K bytes of RAM—all of it battery-powered.

Power Supply

The Model 100 comes with an external AC adapter for use wherever 120-volt AC power is available. In addition, the unit uses four AA penlight batteries so that it can function fully even when AC power is not available. According to Radio Shack, these batteries are good for approximately 20 hours of operation.



```
Dec 28,1982 Tue 14:00:37  (C)Microsoft
 BASIC    TEXT      TELCOM    ADDRSS
 SCHEDL   ADRS.DO   NOTE.DO   -.-
 -.-      -.-       -.-       -.-
 -.-      -.-       -.-       -.-
 -.-      -.-       -.-       -.-
 -.-      -.-       -.-       -.-
Select: _             29102 Bytes free
```

To select an applications program or edit a document, you simply move the cursor to the desired menu item and press Enter.

The time and date information shown on the top line is maintained by a full-time battery-powered clock circuit.

To prolong the life of the batteries, the Model 100 automatically shuts itself off after 10 minutes of waiting for keyboard input (this feature can be disabled using a BASIC command). The memory contents are retained after an automatic shutdown; in fact, when you turn the unit back on again, the previously displayed text is restored.

A low-battery indicator lights up when the batteries have only 20 minutes of life left, and when they do go dead, the Model 100 shuts itself off until new batteries are installed or the AC adapter is plugged in. Even with no batteries and no AC power, the unit will retain data in memory for 8 to 30 days (depending on how much RAM is installed).

How can the computer keep data in RAM without batteries or AC power? A built-in nickel-cadmium (ni-cad) battery pack makes this possible. The ni-cad battery powers the CMOS RAM at all times, and the AC adapter or AA batteries keep the ni-cad pack charged.

There are only three conditions I can think of where the memory contents are lost: during replacement of the ni-cad battery pack perhaps every 2½ years; after a full reset of the system, a special procedure required if the unit hangs up due to malfunctioning software or hardware; or when the unit must be stored for an extended period, in which case the ni-cad battery pack should be disconnected so that it will not be ruined by becoming fully discharged (a memory-disconnect switch is provided for this purpose).

Built-in Modem

The Model 100 includes a direct-connect 300-bit-per-second (bps) modem (Bell type 103). Using a special Radio Shack cable, the computer plugs directly into any modular telephone jack. If you wish, the unit can be installed in series with the telephone set: the telephone is disconnected from the telephone lines while the computer is online, but the phone works normally whenever the computer is offline.

Because the Model 100's modem includes a pulse dialer, you don't need to use the telephone set to place a call to a remote computer. Instead, you simply type in the number on the keyboard or retrieve it from a telephone list you've previously stored in the computer's memory. The modem is able to detect when the remote computer answers the telephone and puts its carrier tone on the line.

Incidentally, you can also use the Model 100 as an auto-dialer for ordinary phone conversations. After the computer finishes dialing, you pick up the telephone handset and press a function key on the computer that activates the telephone.

If you're versed in modem or telephone technology, you might wonder why the Model 100 doesn't include a tone dialer as well as a pulse dialer. Good question. The answer is that none of the tone-dialer integrated circuits are yet available in CMOS form—an energy-saving design requirement for every chip in the Model 100. The lack of a tone dialer could cause minor problems in some private telephone exchanges that cannot handle pulse dialers. In such cases, you must dial the number manually using the telephone set. As soon as the remote computer answers, you press a button on the Model 100 to put the computer online and disconnect the telephone.

The Model 100 is fully battery-powered and fits easily into a briefcase.

The modem allows you to select all the important communications parameters: word length (6, 7, or 8 bits), parity (even, odd, or none), stop bits (1 or 2), full- or half-duplex, and answer or originate mode.

Suppose you want to use the Model 100 with an older, nonmodular telephone installation or even in a telephone booth. In both cases, direct connection is impossible—you need an acoustic coupler that allows the computer to send and receive through the telephone handset. Radio Shack offers an acoustic coupler (a microphone and speaker set inside a pair of rubber cups) as an option; it plugs into the rear panel of the computer.

Other Features

A built-in tone generator opens up a number of possible uses for the Model 100. For example, the unit could be programmed to play a wake-up melody at a specified time. To reduce power consumption, a solid-state, piezoelectric element replaces the permanent-magnet speaker.

Considering its small size and price, the Model 100 has a generous variety of input/output interfaces. A cassette interface lets you store programs and data at 1500 bps using standard audio-cassette equipment. The interface is similar to the one used on the TRS-80 Model III, and, using special input/output software, the TRS-80 Model III and Model 100 can be programmed to exchange ASCII data via cassette tapes.

A parallel Centronics-type interface lets you connect the unit to any of Radio Shack's printers and to most other personal computer printers. An RS-232C standard serial interface provides a convenient channel for local connection to another personal computer or to a variety of peripherals. The interface can transmit information at speeds up to 19,200 bps. Note that because the modem and the RS-232C interface share some circuitry, they cannot be used simultaneously.

An interface for a bar-code reader is also an integral part of the Model 100. This interface has a connector that is plug-compatible with commercially available bar-code wands such as the Hewlett-Packard HEDS-3000. Although bar-code software is not currently provided in the basic unit, Radio Shack has plans to offer a hardware/software package that would enable the Model 100 to read information through this interface, making the computer an ideal tool for inventory and other tasks entailing data collection. The ability to read bar code would also mean that software could be distributed in that form—the cheapest way imaginable. This has long been a dream of many in the personal computer world, and Radio Shack's Model 100 could help it to become a reality.

Potential Enhancements

Next to the ROM expansion socket on the bottom of the Model 100 is a 40-pin connector that makes the system bus accessible to external devices. Radio Shack won't confirm it, but it seems obvious that adding disk drives and an external video monitor would be relatively simple. Of course, a disk controller and video controller would also have to be provided externally. While poking around in the BASIC read-only memory, I came across a list of input/output devices. In addition to the expected CAS:, LCD:, and RAM: (for cassette, liquid-crystal display, and CMOS RAM), I found CRT: (cathode-ray tube, presumably) and a few other surprises. Whatever Radio Shack's plans might be, the options seem wide open.

SOFTWARE

Six programs are permanently stored in the Model 100's 32K-byte ROM. MENU is the program that gives you access to all the others, displaying a file directory and prompting you to select a file. This simple program makes the Model 100 easy for computer novices to use. Also in ROM is Model 100 BASIC, the latest portable computer version of Microsoft BASIC. The language has a number of enhancements that distinguish it from previous versions of the popular BASIC interpreter (see table on page 164).

TEXT is a character-oriented text editor that can work on BASIC programs as well as documents. TELCOM, a data communications program, allows interactive use as well as file transfers. ADDRSS is a text-retrieval system customized for use with addresses and phone numbers, and SCHEDL is a text-

At a Glance

Name: TRS-80 Model 100 Portable Computer

Manufacturer
Radio Shack
1800 One Tandy Center
Fort Worth, TX 76102

Uses
Personal computing, telecommunications, portable word processing, and programming

Standard Features
Keyboard: full ASCII keyboard (256 distinct codes) with full-travel key action plus 8 programmable function keys, 4 command keys, and 4 cursor-control keys; Display: 8-line, 40-column liquid-crystal display with graphics capability (240 horizontal by 64 vertical dot matrix); Microprocessor and Memory: 8-bit CMOS version of 8085 microprocessor, 32K bytes of ROM, 8K bytes of CMOS RAM (expandable to 32K bytes total); built-in direct-connect modem, Bell type 103; piezoelectric element for tone generation; soft carrying pouch; interfaces for audio-cassette recorder, parallel printer, bar-code reader (requires extra software), RS-232C devices, acoustic cups (no additional modem needed); real-time clock; battery or AC operation; Software: Microsoft BASIC, text processing, telecommunications, personal address, and schedule programs; Size: 11¾ by 8½ by 1⅞ inches; Weight: 3½ pounds

Base List Price
$799 for 8K bytes of RAM; $999 for 24K bytes of RAM

Typical System Price
Approximately $1500 for unit with 24K bytes of RAM, audio-cassette recorder and cable, telephone cable (includes introductory Compuserve account), printer cable, and inexpensive dot-matrix printer

Documentation
Owner's manual, reference manual

Options and Accessories
Hard carrying case, acoustic cups for use with nonmodular telephone handset, parallel-interface printer cable

```
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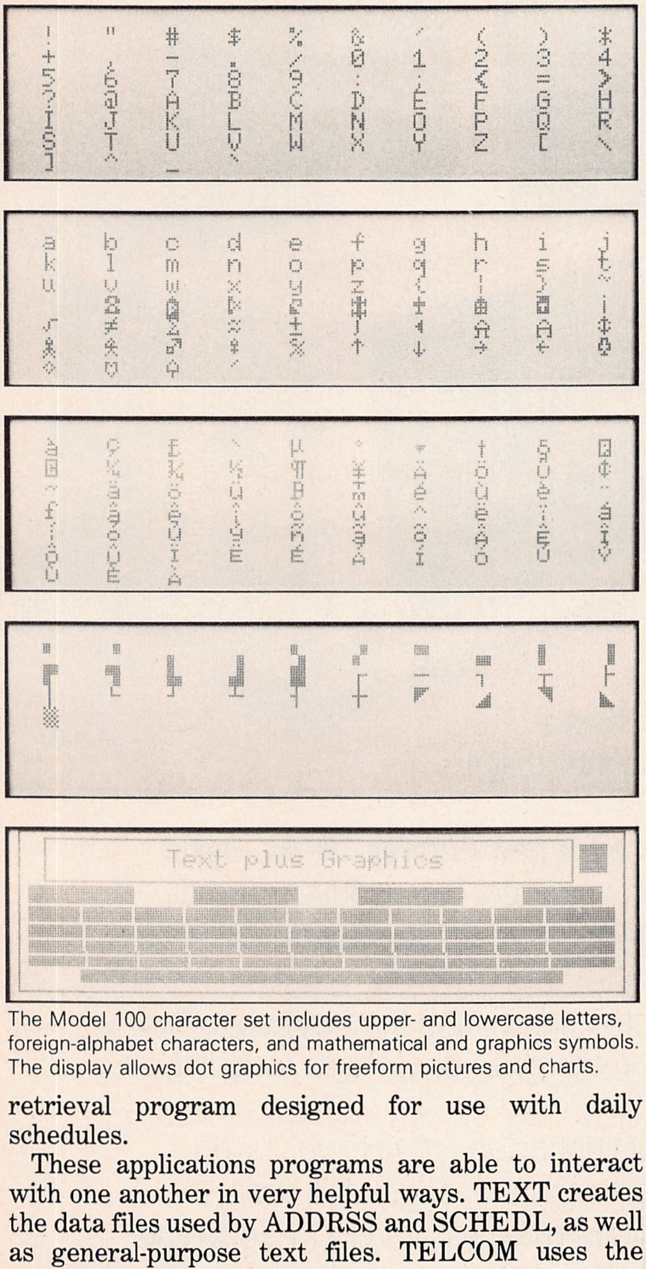

The Model 100 character set includes upper- and lowercase letters, foreign-alphabet characters, and mathematical and graphics symbols. The display allows dot graphics for freeform pictures and charts.

retrieval program designed for use with daily schedules.

These applications programs are able to interact with one another in very helpful ways. TEXT creates the data files used by ADDRSS and SCHEDL, as well as general-purpose text files. TELCOM uses the ADDRSS data file to retrieve prestored telephone numbers, and it creates files that can be processed by TEXT. BASIC commands and programs can be used to perform a variety of operations on any of the files in the system. Text stored in the cut-and-paste buffer while working with TEXT can be recalled in just about any program by pressing the Paste command key. This sort of interaction between programs makes the Model 100 extremely versatile.

Text Preparation Program

This program doesn't have a lot of bells and whistles, but it offers all the essentials for text editing. Thanks to its logical design and efficient use of the Model 100's keyboard, it is extremely easy to learn.

Because TEXT is a character-oriented rather than a line-oriented editor, you can use the cursor-control keys to move freely through the document. As you insert or delete text, the lines on the display are adjusted accordingly. For document editing, such a character-oriented editor is a necessity.

Here are the main commands available using the function keys and command keys:

- Find performs a global search for a specified text string.
- Select defines a block of text to be copied or deleted. Once activated, it lets you use the cursor controls or the Find command to block out the desired text.
- Copy copies the selected block of text into the cut-and-paste buffer for later recall.
- Cut deletes the selected block of text but saves a copy of it in the cut-and-paste buffer.
- Paste inserts the contents of the cut-and-paste buffer at the current cursor location.
- Save writes the text file to a specified device (cassette, modem, printer, etc.).
- Load reads a text file from a specified device (cassette, modem, etc.).
- Exit terminates the editing session and returns you to MENU.

There is one very useful keyboard command that lets you embed control characters in the text to determine printer functions such as underlining and boldface. In addition, a wide assortment of cursor-positioning commands is available.

But there are a few significant limitations to the TEXT program. It has no global replace or delete commands. The display formatter does not suppress spaces at the beginnings of lines, so the left margin sometimes appears ragged. The program's hard-copy formatting is primitive; in fact, setting the printer line width is about the extent of it. You cannot set margins or page breaks or have page numbers printed automatically. If the text contains a printer control code other than a carriage return, the formatter prints a text representation instead of the actual control code. This defeats the purpose of the embedded-control-code feature described above. To its credit, the print formatter does suppress spaces at the beginnings of lines.

However, none of these limitations seriously reduces the usefulness of TEXT for creating and modifying documents. The program was not intended to be a deluxe word processor or print formatter. To avoid overselling TEXT, Radio Shack carefully avoids calling it a word processor, using the term text preparation program instead.

Telecommunications

For the novice computer user, telecommunications can be one of the most frustrating and bewildering of all applications. Generally, TELCOM does far better

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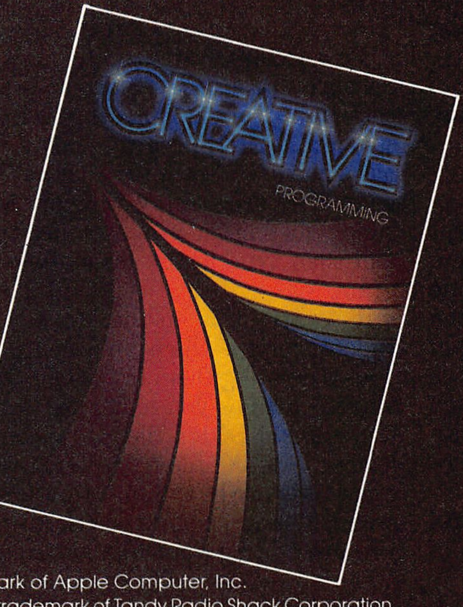

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*Apple is a registered trademark of Apple Computer, Inc.

*TRS-80 Model III is a registered trademark of Tandy Radio Shack Corporation than other communications programs at making things simple, and it makes efficient use of the Model 100's hardware.

When you start TELCOM, it displays the current communications parameters (presented in somewhat cryptic form on the top line) followed by a prompt for input (see photo on page 86). The following commands are available using the function keys:

- Find searches through the address data file for a specified telephone entry and retrieves the pertinent information, including the telephone number and in some cases the log-on sequence required by the computer you are calling. Assuming you have prestored numbers for all your favorite remote data services, you'll never have to look up their numbers or type in their log-on sequences.
- Call either autodials the retrieved number and logs on or lets you type in a telephone number.
- Stat lets you examine or change the communications parameters.
- Term puts the computer in interactive terminal mode.
- Menu exits to the main menu.

While you are online a different set of commands becomes available; these include Download (stores incoming text in a RAM file), Upload (transmits a RAM file), Full (alternates between full- and half-duplex), Previous (recalls the previously received screen of text), Echo (copies the data to the printer), and Bye (disconnects the computer from the telephone line).

The TELCOM program has several other helpful features. The program recognizes the XON/XOFF protocol, which lets one computer tell the other to stop transmitting (XOFF) until further notice (XON). Before TELCOM starts uploading a file to a remote computer, it asks you to specify a maximum line length so you can avoid overflowing the remote computer's input buffer by sending lines that are too long (this feature is lacking in many terminal programs). While in the interactive terminal mode, you can transmit the contents of the cut-and-paste buffer simply by pressing the Paste command key.

Address and Schedule

These two programs are virtually the same except that they use separate data files (ADRS.DO and NOTE.DO). These simple programs do only one thing—search through a data file (created and updated using TEXT) for lines that contain a specified string of text. If the string is found, the line that contains it is displayed on the screen. If there are multiple occurrences, up to three lines at once are displayed; pressing the function key with the soft-key labeled More lets you see the next three occurrences.

As the owner's manual illustrates with several realistic examples, you can increase the usefulness of the program by adding coding characters to each record. For example, in a Christmas list, you might include "*B" in every record that corresponds to a business associate and "*P" in every record of a personal friend. That way you could retrieve the two groups separately by specifying either "*B" or "*P" as a search string.

BASIC

While the other Model 100 software makes things simple for the computer novice, BASIC makes things fun for the programming enthusiast. A lot of territory is packed into the Model 100, and BASIC lets you explore it fully. The summary of BASIC keywords in the table on page 164 suggests the scope of this programming language.

The possibilities for interaction with applications programs are enormous. For example, there's no limit to the processing you could perform on the address or schedule data files—sorting, updating, deleting records, etc. You could also write a print formatter to make up for some of the limitations of TEXT's print routines.

One great surprise about BASIC is its editor; it's not the limited, line-oriented editor familiar to anyone who has programmed in Microsoft BASIC, but rather the TEXT program itself. That's right, the Edit command invokes the Model 100's text preparation program and sets up your BASIC program as the edit file. If you specify a line, then just that line will be displayed for editing. If you omit a line reference, the entire program can be edited at once. You can move up and down through the program and use the Find command to locate specific character strings. You can add or delete lines (deleted lines are kept in the cut-and-paste buffer). When you finish editing and press the Menu command key, you will be returned to BASIC with your newly edited program in memory and ready to go.

A Few Peculiarities

There are a few peculiarities about BASIC in this computer. For example, suppose you have written and saved a BASIC program called SORT. The program has some useful routines that you'd like to copy for use in another program. With most computers, you would simply load in the program, delete the unneeded lines, and then type in the lines needed for your new program.

If you try this on the Model 100 you'll be in for a rude surprise—when you delete the unneeded lines, you're deleting them from the SORT file itself. In fact, all the changes you make are instantly performed on the original SORT file. How can this be? When you load an existing file from RAM, the Model 100 doesn't create a copy of the program for you to work on; instead, it simply points you to the original file. In short, you are editing your file, not a copy of it. This makes

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some sense: because RAM is a precious commodity in an 8K- to 32K-byte machine, it won't do to go about creating extra copies of programs in that RAM.

There is a way to avoid changing your original SORT program, though. Load the SORT program into BASIC, type EDIT to invoke the editor, use Select and Copy to save the text you want to use, exit from the editor to BASIC, and type NEW to erase the pointers to the SORT program. Now press the Paste command key, and the desired lines will appear on the display. A similar sequence is required whenever you want to duplicate any file. This aspect of the Model 100's BASIC will probably cause quite a few headaches among users unfamiliar with the machine, but it does conserve memory. Model 100 owners will soon learn to save programs on cassette to avoid changing them accidentally.

Conclusions

As a piece of computer hardware, the Model 100 is a fine product. An amazing amount of computing power and expandability is built into the package. As a portable computer, it's by far the most practical model I've seen.

Compromises are inevitable in putting together a small package like this. For example, the Model 100 does not include a miniature thermal printer or a cassette drive. On the other hand, though, it does include a parallel printer interface and standard audiocassette interface. If you have to get a printout while traveling, finding a compatible printer will not be difficult in this day and age. Similarly, cassette recorders are inexpensive and compact; the Model 100 can be connected to just about any of them for long-term storage of programs and data. Leaving these devices out of the basic machine gives you more flexibility—important when you consider that printing and mass-storage technologies are still evolving rapidly.

What about the Model 100's memory limitation of 32K bytes of RAM? It would be nice to have 64K or even 256K bytes of nonvolatile bubble memory, but that would drive the cost sky-high. Furthermore, how important is all that extra memory in a portable computer? For text editing, who has time to enter and edit more than a few pages of text while traveling? The memory limitation might be more of a problem in financial modeling and similar programs. Once you have loaded such a lengthy program, very little memory remains for storing significant amounts of data. If Radio Shack comes out with ROMs containing such applications, the full 32K bytes of RAM will be freed up for data storage, which will help somewhat. But again, it's a portable computer, and most users will probably accept the memory limitation in return for the Model 100's versatility, built-in software, and relatively low price.

In summary, I like Radio Shack's new definition of a portable computer. □

Model 100 BASIC Keywords

This comprehensive list will give you a good idea of what can be done using Model 100 BASIC programs. Unusual or enhanced features are highlighted.

GENERAL COMMANDS

CONT—continues program execution after STOP or BREAK

CLEAR—clears variables and optionally resets the size of the user program area

EDIT—enters the TEXT program using the resident BASIC program as a text

KILL—deletes a file from CMOS memory

LIST—displays the resident BASIC program

LLIST—prints the resident BASIC program

NAME—renames a file in CMOS memory

NEW—clears out the BASIC program area

RUN—executes a BASIC program

IPL—(initial program load) specifies a program to be run the next time the computer is turned on

GENERAL STATEMENTS

CALL—calls a machine-language subroutine with optional parameter passing

DATA—stores numbers and strings inside a BASIC program

DEFINT—defines variables as integer data type

DEFSNG—defines variables as single-precision data type

DEFDBL—defines variables as double-precision data type

DEFSTR—defines variables as string data type

DIM—dimensions an array; multidimension arrays are allowed

END—ends execution of a BASIC program

ERROR—simulates an error

FOR. . .NEXT—sets up a program loop

GOSUB. . .RETURN—calls and returns from a BASIC subroutine

GOTO—jumps to another BASIC program line

IF. . .THEN. . .ELSE—performs a specified action according to the results of a test

IF. . .GOTO. . .ELSE—performs a specified action according to the results of a test and jumps to another line in the BASIC program

INPUT—inputs data from the keyboard with an optional prompting message

LET—assigns a value to a variable (optional)

LINE INPUT—inputs a line of text

LPRINT—outputs data to the parallel printer port

LPRINT USING—outputs formatted data to the parallel printer port

ON ERROR GOTO—sets up an error-handling subroutine

ON. . .GOSUB. . .RETURN—calls and returns from one of a list of BASIC subroutines

ON. . .GOTO—jumps to one of a list of BASIC program lines

OUT—outputs one byte to a microprocessor input/output port

POKE—stores one byte in the CMOS memory

PRINT—outputs data to the LCD

PRINT USING—outputs formatted data to the LCD

READ—assigns data from DATA statements to variables

REM—indicates a remark to be ignored by the BASIC interpreter

RESTORE—resets the pointer used by READ to indicate the current DATA line; a line number may be used

RESUME—continues normal program execution after an error

STOP–interrupts program execution

GENERAL FUNCTIONS

ABS–computes the absolute value

ASC–computes the ASCII code

ATN–computes the arctangent

CDBL–converts to double-precision data type

CHR$–converts a numeric code to a literal string

CINT–converts to integer data type

COS–computes the cosine

CSNG–converts to single-precision data type

EOF–tests for end of file

ERL–returns the line number of the latest error

ERR–returns the error code of the latest error

EXP–computes exponentiation

FIX–computes the integer part of a number

FRE–computes the amount of free memory remaining

INKEY$–inputs a keyboard character if available

INP–inputs a byte from a microprocessor I/O port

INPUT$–inputs a specified number of keyboard characters

INSTR–searches for one string within another string

INT–computes the "floor" function (smallest integer not exceeding the input argument)

LEFT$–returns the left-hand portion of a string

LEN–computes the length of a string

LOG–computes the natural logarithm

LPOS–computes the current print-head position in the line-printer buffer

MID$–returns the middle portion of a string

PEEK–returns the contents of one byte of CMOS memory

POS–computes the current cursor position on the LCD

RIGHT$–returns the right-hand portion of a string

RND–computes a pseudo-random number between 0 and 1

SGN–computes the sign of a number

SIN–computes the sine

SPACE$–returns a string of spaces

TAB–advances the display cursor or printer buffer to the specified column position

TAN–computes the tangent

VAL–converts a string to the number it represents

VARPTR–computes the address in CMOS memory where a variable or file-control block is stored

OPERATORS

NOT–negates on a true/false or bit level

+ – */–perform standard arithmetic operations

\\ –performs integer division

MOD –performs modulo arithmetic

AND,EQV,IMP,OR,XOR –compare on true/false or bit level

< = > <> <= >= –compare numbers or strings

INPUT/OUTPUT AND MISCELLANEOUS

BEEP–makes a beeping sound through the piezoelectric element

CLOAD–loads a BASIC program in compressed or ASCII form

CLOAD?–compares a BASIC program stored on tape with the resident one

CLS–clears the screen

COM ON/OFF –turns an RS-232C communications interrupt handler on or off

CSAVE–saves a BASIC program on cassette in compressed or ASCII form

CSRLIN–computes the current display line number

CLOSE–terminates output to a file or device

DATE$–returns or sets the date

DAY$–returns or sets the day of the week

FILES–displays the files stored in CMOS memory

HIMEM–returns the highest address used in the BASIC work area (HIMEM is always less than or equal to MAXRAM)

INPUT #–inputs data from an open file or device

KEY ON/OFF–assigns a function to one of the eight function keys

KEY LIST–lists the currently assigned function-key definitions

LCOPY–copies the current text image on the screen to the printer

LINE–draws a line or box on the display

LINE INPUT #–inputs a line of data from an open file or device

LLIST–lists the resident BASIC program to the parallel printer port

LOAD–loads a BASIC program from a file or device

LOADM–loads a machine-language program

MAXRAM–returns the highest address available for use by BASIC

MDM ON/OFF–turns a modem interrupt handler on or off

MERGE–merges a stored program from a file or device with the resident one

MOTOR–turns the cassette motor on or off

ON COM GOSUB–sets up an interrupt-handling subroutine to take over in case of data coming in from the RS-232C interface

ON KEY GOSUB–sets up a key-interrupt subroutine to take over when the specified function key is pressed

ON MDM GOSUB–sets up an interrupt-handling subroutine to take over in case of data coming in from the modem

ON TIME$=...GOTO–sets up an interrupt-handling subroutine to take control at a specified time

OPEN–prepares a file or device for input/output

POWER–turns the Model 100 off, sets the duration after which the computer will turn itself off while waiting for keyboard input, or disables the shutoff feature

PRINT @–positions cursor to a screen location before printing

PRINT #–outputs data to an open file or device

PSET–turns on an LCD point

PRESET–turns off an LCD point

SCREEN–selects which device is used as the console output and enables or disables the soft-key label feature (LCD is the only currently available console output device)

SAVE–saves the resident BASIC program to a file or device

SOUND–plays a note through the piezoelectric element

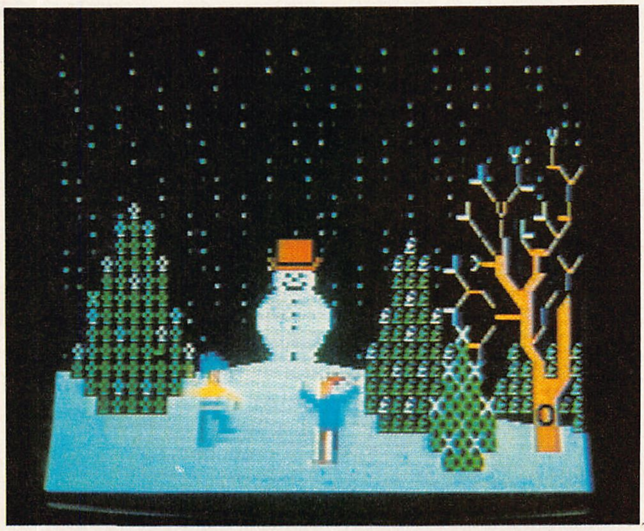
SOUND ON/OFF–enables or disables automatic playback of incoming data during input from modem or cassette

TIME$–returns the time

TIME$ ON/OFF–enables or disables a time-based interrupt-handling subroutine

SAVEM–saves a block of CMOS memory to a file or device in machine-language format

RUNM–loads and runs a machine-language program from the specified file or device



An example of sprite graphics.

CONTINUED FROM PAGE 98

the Commodore 64 to run most PET software (with the help of an optional PET emulator cartridge), it makes for some additional complications as well.

When you turn on the 64 it starts in the uppercase/graphics mode. Any alphabetic character you type appears as an uppercase character on the screen. If you type a shifted character, you will see the graphics character shown to the right on the front of the key. Using the Commodore key (in the lower left corner of the keyboard) instead of the shift key will give you the graphics character to the left on the front of the key.

Wait a minute—where are the lowercase letters? To switch the computer to a normal upper- and lowercase mode, you must press the Commodore key and the shift key simultaneously. But this mode does not allow you to display the graphics characters on the right front of the keys. Even worse, in this mode uppercase letters are not recognized by the BASIC-language interpreter and will cause the less-than-descriptive "SYNTAX ERROR" message to appear. So, if you program in BASIC, you'd better stick with the uppercase/graphics mode, which also allows access to all graphics characters. If you want to do word processing, you'll want the conventional upper- and lowercase mode.

To get back to uppercase/graphics mode, just press the Commodore key and the shift key simultaneously again. But watch out! Any lowercase letters that were already on the screen will turn into uppercase, and all the uppercase letters will become graphics characters. Needless to say, these two character sets can be a great source of irritation at first because they're so confusing, but many people seem to adjust to them after a while.

The 64 does not use the 128-character American National Standard Code for Information Interchange (ASCII). It does generate all of the ASCII characters except for backslash, underline, braces, vertical bar, and tilde (which are not used that often), but not in the standard order. Because of this unique arrangement, you'll need to translate when communicating with computers or devices other than those made by Commodore. This is handled by communications software such as the 64-Term package that comes with the VIC-modem.

You can print 157 distinct characters as part of the two 256-character sets. Many characters in one set are repeated in the other or are control characters that don't print. Characters can be displayed in reverse image and in any of 16 colors. In addition, the characters are programmable so that you can define the shape of the 8 by 8 grid of dots that makes up each character. This allows tremendous flexibility for games and business applications.

The Display

The Commodore 64 displays 25 40-character lines on your television screen or monitor. The 40-column limit was chosen because televisions, which provide the most cost-effective color displays, cannot effectively show more than 40 characters per line.

Many computers now provide 80 characters per line on a video monitor, but Commodore has no plans to offer an 80-column adapter. Other companies are certain to produce such adapters, which would let you see the full width of a document as it will be printed. This is important for most word-processing and business applications.

The display starts with light blue letters on a dark blue background. This is attractive but does not provide good contrast. Changing the color to white on the dark blue background gives a more readable display.

You can easily change the color of the next character to be printed using the control (CTRL) or Commodore key like a shift key with the number keys 1 through 8. The 16 colors are beautiful to work with—more computers should have this richness of expression. The colors include black, white, red, cyan, purple, green, dark blue, yellow, orange, brown, light red, light gray, medium gray, light green, light blue, and dark gray. Depending on the color adjustment of your television set, the purple may come out pink and the brown may be more of a shade of orange.

The 16 colors are beautiful to work with. More personal computers should have this richness of expression.

The background can be displayed in any of 16 colors as well, making unreadable character/background combinations possible. The restore key comes to your rescue in this situation. If you type the restore and

At a Glance

Name: The Commodore 64

Manufacturer
Commodore Business Machines Inc.
Computer Systems Division
487 Devon Park Dr.
Wayne, PA 19087

Hardware
Size: 16 inches wide, 8 inches deep, 3 inches high
Electrical needs: 120V AC for external power supply
Microprocessor: MOS Technology 6510 (6502 with 8-bit input/output port)
Memory: 20K bytes of built-in ROM (read-only memory), 64K bytes of built-in user RAM (random-access memory)
Standard features: 66-key typewriter-style keyboard, four special function keys, program or game cartridge slot, two game controller ports, television connector, audio/video connector, serial port for disk drive(s) and/or printer, audio-cassette recorder connector, user port for modem cartridge or RS-232C communications cartridge, time-of-day clock, 40-column by 25-line screen display, 16 colors for text and background, two character sets with a total of 256 ASCII and special graphics characters each, 320-by-200 high-resolution graphics mode, eight independently movable sprites (21 by 24 dots with up to four colors each), music synthesizer that produces three independent voices with a range of nine octaves each, Commodore BASIC-language interpreter
Disk drives: up to four optional 5¼-inch floppy-disk drives (170K bytes each)

Software
Operating system: Commodore Kernal
Languages: Modified Microsoft BASIC standard, Logo ($99.95), UCSD Pascal, PILOT, COMAL, Commodore 64 Assembler, BASIC Compiler
Applications: Easycalc ($99.95), Easyplot ($99.95), Easyfinance ($79.95), Easyschedule ($79.95), Easyfile, Easyscript, Easylesson, Easyquiz, The Word Machine, The Name Machine, Commodore Mail Mate, Wordpro 3 Plus ($89.95), Commodore Screen Editor, Commodore Video and Music Support Package, Commodore 64 Computer Tutorial, PET Emulator ($29.95), Commodore 64 DOS Wedge, Meta Music I, Assembler Tutor, Commodore BASIC Language Tutorial
Games: Avenger, Jupiter Lander, Road Race, Omega Race, Super Alien, Radar Ratrace, Mole Attack, Money Wars, Bingo Math, Wizard of Wor, Kick-Man, Gorf, Clowns, Sea Wolf, Tornado Baseball, Bowling, Spiders of Mars
Communications: 64-Term, Home Terminal, Office Terminal

Hardware Prices
Standard system with system unit, 64K bytes of RAM, power supply, video cable, and TV switchbox: $595
Typical system price with one disk drive: $994

Popular Accessories
VIC-1530C2N Datasette audio-cassette recorder: $75
VIC-1541 single disk drive: $399
VIC-1525E dot-matrix graphic printer: $395
VIC-1600 VICmodem telephone interface cartridge: $109.95
RS-232C interface cartridge: $49.95
IEEE-488 interface cartridge: $99.95
Z80 cartridge (price not available)

Documentation
Commodore 64 User's Guide (included); *Commodore 64 Programmer's Reference Guide* ($19.95); *Commodore, The Microcomputer Magazine* ($15/year); *POWER/PLAY* ($10/year); *Commodore Software Encylcopedia* ($9.95); *Educational Marketing Resources Book* ($26.95); Commodore Information Network ($5/hour)

run/stop keys simultaneously, the computer will be reset to its original condition and the display will be cleared *without* losing the program in memory. This is a very useful feature if you are trying some of the graphics or sound features and want to clear the screen and return to the normal starting condition. The border surrounding the 40-column by 25-row text area can also be set to any of the 16 colors.

Graphics

The Commodore 64 has an impressive array of graphics capabilities. The three general modes include 40-column by 25-line character graphics, 320- by 200-dot high-resolution graphics, and sprite graphics. *Sprites* are large programmable characters that can easily be moved around. Combinations of these modes can also be displayed on the screen at once.

The basis for much of this graphics capability is the memory capacity of the Commodore 64. Each character location on the screen (40 × 25) has a corresponding location in the computer's memory, creating what is called a *memory-mapped display*. Whenever one of the computer's 256 possible characters is put into one of the 1000 video-memory locations, the character also appears in a corresponding place on the screen. A color-memory area keeps track of the color of each character.

By putting appropriate graphics characters in the video memory and the color of each graphics character in the color memory, you can become quite an artist with the 64. The catch is that this can be difficult to accomplish when using BASIC.

Commodore BASIC version 2.0 has only one command that can do all this: POKE. POKE will take a value (one byte) and put it into a specific memory location. The instruction POKE 1024,1 will put the letter A (character 1) into the upper left-hand corner of the screen (memory location 1024).

This poke-by-number approach is not a very friendly way to teach budding young artists to paint with the Commodore 64. The optional BASIC expansion cartridge offers a video and music support package with simple commands like COLOR, PLOT, CIRCLE, and LINE and should provide a much better way to use the 64's graphics.

Would you like to teach your computer Russian or Greek? The programmable character set lets you redesign each of the 8- by 8-dot characters that can be typed from the keyboard. Multicolored characters are also possible.

The programmable characters are also used to create high-resolution graphics with some color limitations. Each picture is worth 8000 words (bytes). Eight bytes are needed to define the 8- by 8-dot characters at each of the 1000 screen positions. This allows for a 320- by 200-dot image in which each 8- by 8-dot grid is limited to two colors. A multicolored medium-resolution image is also possible. Each 8 by 8 character in the 160- by 200-dot medium-resolution mode can be any one of four colors. Smooth scrolling—moving the entire screen image horizontally or vertically one dot at a time—is also possible.

Needless to say, specifying all these values in Commodore BASIC version 2.0 can become quite a complex task. But you can do some amazing things with a bit of patience. So if you're ever in the state of Missouri, take along a Commodore 64 and show the proverbial skeptic what it can do.

Sprites and Animation

Sprites are the elves of computer graphics. You don't have to give them much direction, and they'll keep working all night. A sprite is a large (24- by 21-dot) programmable character whose shape and color you can define. It's very easy to move sprites around on the screen, and they can move independently of other sprites and graphics. They can also pass in front of or behind each other or parts of the background to give a three-dimensional quality to your animation. Even though sprites are one of the most powerful means of creating graphics, few computers have them. The Texas Instruments 99/4A uses them for Logo and other applications, and the Atari 400/800 series (which calls them player/missiles) uses them in the excellent arcade-quality games for which it is famous.

The Commodore 64 has eight sprites that can be mixed with other graphics modes. You just give each sprite a shape, color, and an *x-y* coordinate location and off to work they go.

If 24- by 21-dot sprites aren't big enough for you, you can double the size of a sprite horizontally, vertically, or both. This is at the expense of resolution because the existing sprite is merely expanded. A multicolored-sprite mode trades horizontal resolution for up to four colors in each sprite.

Which sprites pass in front of others is determined by the number assigned to each sprite. Sprite 0, which has the highest priority, will appear to be closer than sprite 1 because it passes over sprite 1 whenever the two meet. You can also make each sprite pass in front of or behind background objects. Collisions between sprites or between sprites and background objects are detected separately, and the results can be used in games and other animation projects.

It is possible to write decent arcade-style games in BASIC because the special video chip quickly handles the position and motion of the sprites. Sprites are so independent that they'll remain on the screen even after you stop a BASIC program by pressing the run/stop key. Typing the run/stop and restore keys together will clear the screen, however.

As with the other graphics modes, Commodore BASIC version 2.0 doesn't have any specific sprite commands. All sprite activity is managed through POKE commands to memory locations unless you have the video and music support package in the BASIC expansion cartridge, which provides commands to move sprites around more easily.

Creating Music

You can be a one-computer band with Commodore's three-voice music synthesizer, an option that effectively turns your computer into a musical instrument. The Commodore 64 simulates the sounds of many acoustical instruments better than any other personal computer available today.

The synthesizer's three independent voices mean that three notes can be played simultaneously. Each of these voices can sound like a different instrument. Take your pick from organs, violins, brass, woodwinds, strings, pianos, harpsichords, drums, guitars, and special sound effects. An almost infinite range of combinations is available through the flexibility of the special Sound Interface Device (SID) chip.

The synthesizer gives you a great deal of control over the quality of the three voices. Each voice has an eight-octave range, a sound-envelope generator with programmable attack/decay/sustain/release (ADSR), and a choice of waveforms. A volume control for all of the voices and a programmable filter for different frequencies round out the offerings.

The eight-octave equal-tempered musical scale in concert pitch indicates that the 64 has aspirations to play Carnegie Hall. The ADSR generator defines how quickly a note rises from silence to its peak volume (attack), the rate at which it falls from peak volume to a sustained volume (decay), the level of the sustained volume (sustain), and the rate at which it falls from the sustained volume to silence (release). A drumbeat has a very simple ADSR shape: instantaneous attack and decay with no sustained volume or release. A violin is a sustained instrument with variable rates of attack, decay, and release.

The synthesizer's three waveforms affect the quality of a sound. The triangle waveform is smooth and flute-like; the sawtooth is sudden and brassy; the pulse waveform is adjustable from a bright, hollow sound to a nasal, reedy one. The noise generator produces sounds from a low rumble to a high-pitched hiss.

The optional BASIC expansion cartridge offers a support package with simple commands. This is a far better way of using graphics than the standard BASIC 2.0 provides.

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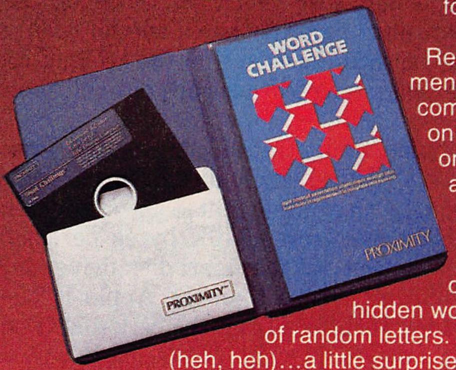

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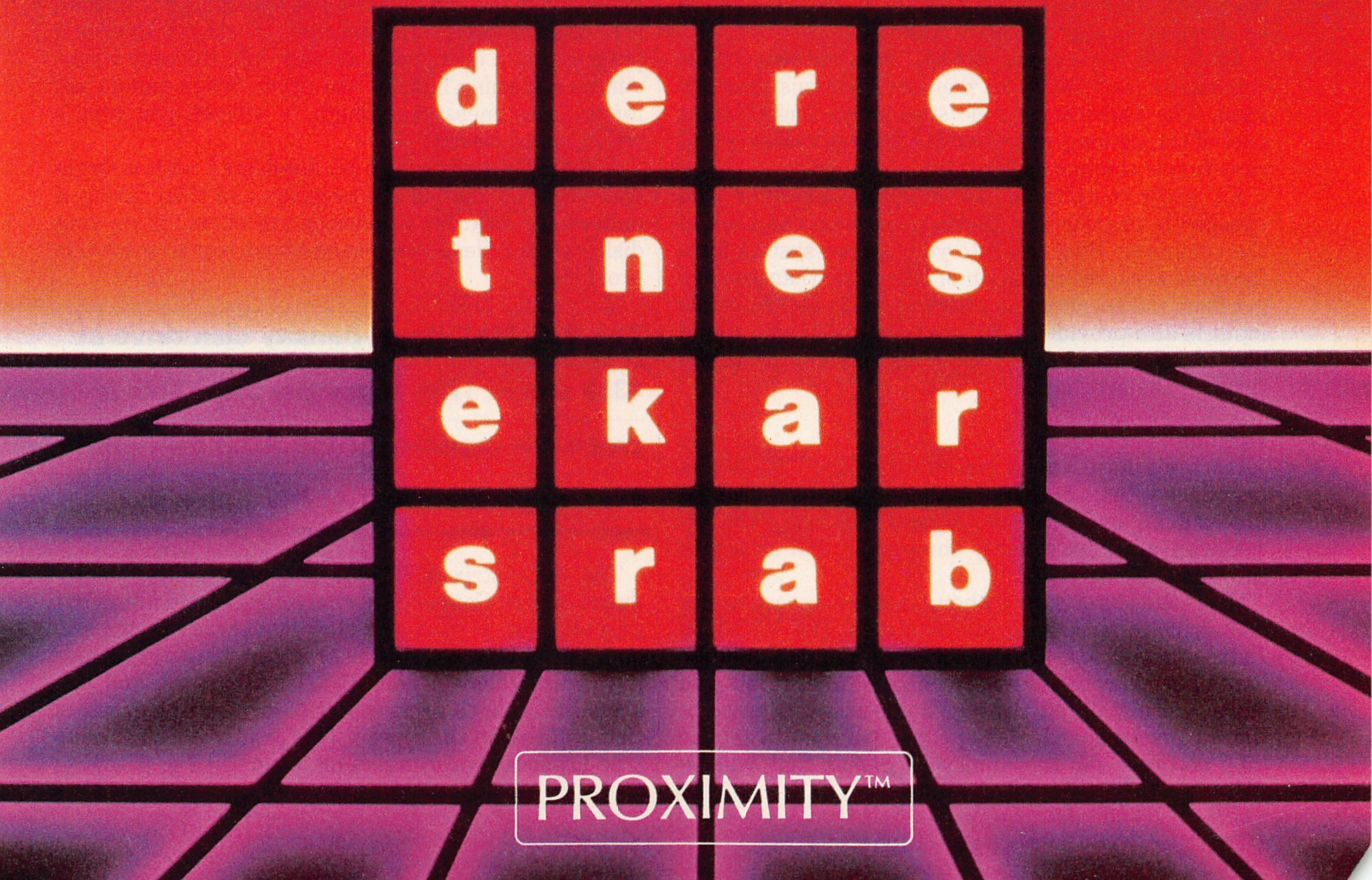

d	e	r	e
t	n	e	s
e	k	a	r
s	r	a	b

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The programmable sound filter allows three types of filtering to get a sound just the way you want it. It can be used for high-pass (passes high frequencies through), low-pass (passes low frequencies), band-pass (passes a narrow band of frequencies), and notch-reject filtering (does not pass middle frequencies). Vibrato and bell sounds are also possible.

The synthesizer can produce many sounds that cannot be duplicated by acoustical instruments. By applying the sound envelope of one instrument to the harmonic structure (waveform) of another, you can create "new" instruments. Sound effects like explosions, wind, or bells can be used in games and other interactive programs.

To play one of the 94 notes requires turning the master volume on, setting the attack/decay rates and sustain/release levels, entering the low-frequency and high-frequency values of the note, and finally starting the waveform. To turn off a note, just release the waveform. Only the note values and waveform need to be changed to play a second note.

The three-voice music synthesizer simulates the sounds of acoustic instruments better than any other personal computer.

Again, the Commodore BASIC does not have music commands, so POKEs to memory locations must be used. The video and music support package that is part of the optional extended BASIC provides a set of easy-to-use commands for music making.

An audio output to an external amplifier and speaker is provided by the connector on the back of the computer. Plug this into your stereo system for a far more accurate rendition of the music than you can get from the speakers on your television set. An audio input is also provided for the adventurous who would like to combine or filter their instruments or voices through the synthesizer.

Options

It wasn't until several months after the VIC-20 was introduced that options became available. The 64 takes advantage of that development, as many VIC accessories are now directly compatible and attach to the 64's existing ports.

Most people purchase either a cassette recorder or a disk drive to store programs and data. The VIC-1530 Datasette audio-cassette recorder is suitable only for limited use because of its slow access time. It lets you store information on low-cost audio-cassette tapes at the expense of speed. Many people will want to get the tape recorder for the numerous games that will be available on tape and cost less than those on cartridges. The Datasette recorder has a special connector that fits the cassette interface on the back of the computer. Other cassette recorders are difficult to attach.

The most popular configuration sold is the Commodore 64 with a VIC-1541 single disk drive. Another price breakthrough, this intelligent $399 single-density 5¼-inch disk drive stores 170K bytes per disk. This is twice the capacity of the Atari disk drive (88K bytes) and significantly more than the Apple II disk drive (114K bytes). It differs from the VIC-1540 disk drive only by a new ROM chip. Disks made on the VIC-1540 and on the older CBM 4040 dual disk drive can be read with this drive.

Up to four floppy-disk drives can be connected end to end with a series of cables from the serial bus port. Using serial communication (one bit at a time) for the disks supposedly slows down the performance of the drive, but the Apple II disk drives, which use parallel communication (eight bits sent at a time on eight wires), are not any faster.

The disk controller (with its own 6502 microprocessor) and the disk operating system are built into the disk drive. This intelligence in the drive allows the computer to pass a command to the drive and then continue about its business while the drive carries out the command. It is not so convenient in the event of an error: the drive light blinks, but the computer won't know about the error unless you specifically command it to ask the drive. For example, if you try to save a program on a disk that's already full, the only result will be a flashing light on the drive. When you do ask for an error message, though, it will tell you what's wrong quite clearly.

A BASIC program can be duplicated with a single disk drive by loading the program and then saving it on another disk. No provisions are made for copying disks or data files—you'll need two drives to solve this problem.

The VIC-1541 single-density disk drive at $399 stores 170K bytes per disk. This is twice the capacity of the Atari disk and even more than that of the Apple II.

The dot-matrix VIC-1525 graphics printer reproduces the full Commodore character set and offers dot graphics, but it runs at a slow 30 characters per second. The ability to print the graphics characters is nice if you use them in your BASIC programs, and you should be able to print copies of any text or graphics that appears on the screen. This printer does not have true lowercase descenders on letters like g, p, and y;

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instead it raises these characters up on the print line. You can connect this printer to the serial port or to the last disk drive plugged into the serial port.

Other Commodore printers can be added by using a standard IEEE-488 interface. This option plugs in the cartridge slot and lets you use the Commodore version of the Epson MX-80 dot-matrix printer or the Diablo 630 letter-quality daisy-wheel printer. Parallel printer interfaces available from other companies will connect many of the standard parallel printers. These interfaces do the necessary conversion from the Commodore characters to standard ASCII characters. They usually plug into the serial port, leaving the user port open for a VICmodem or RS-232C device.

Commodore has had the foresight to offer optional cartridges for the CP/M operating system and the Logo computer language.

The Commodore 64 provides all of the standard RS-232C serial communications signals in the user port, but not at the standard voltages. An RS-232C interface is required to fix this and allow the 64 to communicate with the many modems, printers, speech synthesizers, and other accessories that use this standard interface. The user port can also be configured as an 8-bit parallel port, but the information on doing this is sketchy. It is not supported in BASIC other than by using PEEKs and POKEs to different memory locations.

The VIC-1600 VICmodem is a telephone-interface cartridge that plugs into the user port and allows you to communicate over the telephone line with information services and other computers at 300 bits per second. At $109.95, this modem is far cheaper than adding a modem and serial port onto other low-cost computers because it uses the existing RS-232C serial port. The price of the modem also includes a one-year subscription to Compuserve with an hour of free use. If you type GO CBM at the first Compuserve prompt, you will enter the Commodore Information Network, an electronic magazine with Commodore news, a hotline for answers to your burning questions, directories of dealers and user groups, and Commodore tips that answer frequently asked questions.

You can also use the modem to contact other popular information services (such as The Source or Dow Jones News and Quotes) and to communicate with numerous computer bulletin boards and other computer users across the country. (Caution: telecomputing has been known to result in marriages.)

A simple communications program for using the VICmodem can be typed in from the manual (delete line 400, which is for the VIC-20). For more advanced features such as different colors for the text you send and receive, you can take the VIC-Term cassette (for the VIC-20) into your dealer and get a copy of the new 64-Term.

One inconvenience with the VICmodem is the way it attaches to the telephone. With most direct-connect modems you can disconnect the cable leading to the back of the telephone and plug it right into the modem. You can also split the signal with a readily available adapter so that both the telephone and the modem are attached at the same time. The VICmodem does neither of these; you have to disconnect your handset (the part you speak into) and plug the cable that normally goes from telephone to the handset into the modem.

To use the VICmodem you must dial the phone number with the telephone, hear it answer, disconnect the handset cable, and plug it into the VICmodem. Because the handset connector is smaller than the one on the back of the telephone, you not only need good fingernails but also cannot use common adapters to have both the VICmodem and telephone hooked up at once.

Commodore also plans to provide a Z80-microprocessor cartridge, allowing use of the CP/M operating system and its thousands of business programs and computer languages. The accompanying disk with the CP/M disk operating system gives you a 52K-byte operating system and program area. One third of Apple II owners have purchased a similar plug-in CP/M option for the standardization, power, and portability it provides. This should prove to be one of the most popular options for the Commodore 64 as well.

The 300 bps VIC-1600 VICmodem at $109.95 is far cheaper than adding a modem and serial port to other low-cost computers because it uses the built-in RS-232C serial port.

While CP/M makes great strides toward standardization among 8-bit computers, the many different disk formats stand in the way. You cannot take an Apple II CP/M disk or an Osborne 1 CP/M disk and use it on the Commodore 64. The VIC-1541 disk drives offer yet another nonstandard format for CP/M software manufacturers.

BASIC

Commodore feels that most users will buy the 64 not for programming in BASIC but for running prepackaged programs for business, education, and home use.

This concept has left the 64 with a weak version of BASIC. Commodore BASIC 2.0, a modified subset of the standard Microsoft BASIC, differs substantially from the standard in its graphics, handling of files, and other input/output commands. Memory needed for BASIC (8K bytes) has been minimized at the expense of convenient commands for handling disk files, graphics, and sound. An 8K-byte BASIC expansion cartridge will be available to enhance the graphics, color, and music commands.

Turning the computer on causes a two-second pause during which the screen is blank as the computer checks for a game or program cartridge, initializes itself, and does a test of its memory. Then BASIC signs on and displays the message that 38,911 bytes of memory are free and available for programming. This is more than ten times the program work space available on the VIC-20. The 64 could easily support a more powerful BASIC, but Commodore still thinks in terms of small, cryptic programs even though the days of limited memory are drawing to a close.

Program lines, for example, can be no more than 80 characters long, and only the first two letters of the names of program variables are used. Indentation to clarify the program structure is not allowed.

Business users especially should be wary of Commodore's cumbersome BASIC. For example, to get a directory of the files on a disk you type LOAD“$”,8 and then type LIST to see a pseudo-BASIC program that shows the disk's name followed by the files and their sizes. A shorter method involves running the program called C-64 WEDGE (from the disk provided with the drive) and then typing >$ to get a directory of disk files. Both of these approaches are somewhat cryptic and do not lend themselves to easy use in a business environment. Other computer systems have far simpler commands like FILES or DIR (for directory).

The screen editor in BASIC is a joy to work with as it lets you easily change any line on the screen. Use the cursor key to position the cursor over any mistake and just type the correction in. You can also insert and delete characters with the insert/delete key as if you were using a word processor. When you press Return while the cursor is anywhere on the line being changed, the new line replaces the old one. Even the line number of a BASIC program can be changed, allowing you to duplicate similar lines quickly.

Many of the BASIC keywords are available in a shorthand form by typing the first letter or two and then the next letter in a shifted mode. If you use BASIC frequently, this can be a time saver once you memorize the codes.

The quote mode in BASIC allows you to store in strings of characters between quote symbols commands for clearing the screen, changing character colors, and moving the cursor. This can be handy, but it is not always clear what the reverse symbols generated by these commands stand for. Remembering that the reverse heart shape clears the screen is easy, but the other odd combinations of reversed characters and their meanings can be very confusing. Commodore tends to use these reverse codes in its programs, and it's difficult to type in those programs if you don't know the command that creates the reverse character in the listing. You will also need a Commodore printer to print out listings with reverse characters in them.

Files and data are handled according to the same rules as used in earlier versions of BASIC for the PET and VIC-20. After a device is opened, the instructions are similar no matter whether you are using tape recorder, disk, or printer. You can easily redirect input or output by changing the device number used or by using a command channel. Because both BASIC and the intelligent disk drive are involved in file handling, you have to be careful that they close files together. Otherwise you can end up with problem files that haven't been closed properly and leave holes on the disk for your data to stumble into.

Commodore has no plans to offer Commodore BASIC 4.0, a more powerful, extended BASIC that takes up more memory but has better commands for the disk system. Other companies are working on making this available. The CP/M option provides a better system, but you would have to unplug it to be able to take advantage of inexpensive software designed specifically for the 64.

Other Languages

Logo is the darling computer language of the educational community. Logo availability can sell computers to schools the way Visicalc sold Apple IIs to businesses. Some school systems have decided that they will purchase only computers that offer Logo.

Using Logo's turtle graphics to illustrate programming concepts simplifies learning a computer language. Logo lets you see what your program is doing as the turtle draws patterns on the screen. If the turtle doesn't act the way you thought it would, you can get up and “play turtle” by walking through the instructions you have given the turtle.

Teaching the computer new Logo commands or procedures gives students a sense of control over the computer. These procedures can also be used to break a problem down into parts for a modular approach to programming. Procedures can call other procedures for information, or they can even call copies of themselves in a powerful technique called recursion.

Commodore Logo features high-resolution turtle graphics with 16 colors and a 25 percent larger work space than Apple Logo provides. The commands are similar to the MIT version of Logo distributed by Terrapin Inc. and Krell Software. Logo will be available in either disk or cartridge form.

Other computer languages Commodore has announced for the 64 include UCSD Pascal, the most popular version of Pascal; PILOT for computer-aided instruction; assembly language for experienced users; COMAL, the European public-domain language; and a PETSPEED BASIC compiler to speed up BASIC programs.

Software

The key to success for the Commodore 64 will be the availability of software. The company has embarked on an ambitious plan, announcing dozens of programs for the 64, but few are available at this time. The intentions are impressive—we'll have to see how they are carried out.

The key to success for the Commodore 64 will be the availability of software. Commodore has announced dozens of programs, but few are yet available.

Equally ambitious is the pricing of the software for the Commodore 64. All Commodore programs and computer languages will cost less than $100. Third-party software publishers are following this lead, giving the 64 some of the most reasonably priced programs ever seen. To slow down illegal copying of disks and programs, Commodore will be copy-protecting many of the disks, putting programs in cartridges, or using a hardware key that must be plugged into the computer before the program will run.

New software is needed so that the average user can more easily control the Commodore's powerful features. The company has drawn on its international presence and is offering many programs from Canada, England, and other countries, but because most of these programs were originally developed for the Commodore PET, they do not take advantage of the powerful features the 64 offers.

Business Applications

An "Easy" series is Commodore's alternative to the popular Visicalc and its derivatives, which Visicorp has no plans for implementing on the Commodore 64. Easycalc is an electronic spreadsheet for business managers that lets you calculate projections on data stored in a row-and-column format. The 999-row by 65-column format is so large that it exceeds the memory capacity of the 64. Easyplot converts the numerical data from Easycalc into charts and graphs for easy interpretation. Easyfinance has several common decision-making calculations built into it. Easyschedule is an electronic calendar to help organize your time and priorities. Easyfile is a database program that helps keep track of data by arranging it in files and sorting it. Easyterm is an adaptation of Mcterm, the popular communication program for sending and receiving information and files over the telephone. Easyscript provides a full-screen editor for word processing.

Wordpro 3 Plus will probably be the top-selling word-processing program for the Commodore 64. It receives high marks from users and dealers, and its developer, Professional Software Inc., has dominated word processing for Commodore computers. An accounting system called Management Accounting Software is already available for the Commodore 64 from Info Designs Inc.

Educational Software

Commodore boasts of having sold more educational computers worldwide than any other manufacturer, and this has especially been true in Canada and Europe. The company has been very successful at getting its computers into the schools in this country by offering three computers for the price of two. Commodore's current educational discount amounts to about 20 percent off the retail price.

This broad base of computers has spawned thousands of educational programs from which Commodore has selected and cataloged a 50-disk, 656-program set. These public-domain programs, available to schools and dealers, cover school administration, business, English, French, games, geography, history, mathematics, and science. Except for a few with unusual graphics, all of the programs have been converted to run on the Commodore 64. Because they were developed for the PET, however, they don't necessarily take advantage of the 64's special capabilities.

Home and Personal Software

The most popular use of computers in the home is for games. Commodore has obtained licenses for arcade games like Gorf, Omega Race, Clowns, and Sea Wolf to make versions for the Commodore 64. Cartridges and cassette tapes will be available for Pac-Man and Space Invader look-alikes, chess, coordination games, adventure games, and other arcade-style games.

More practical software for the home includes The Word Machine for notes and simple letters and The Name Machine for names and addresses. Tutorials on computer use, music, BASIC, and assembly language are also in the works.

Software from Other Computers

A PET Emulator allows the Commodore 64 to run many of the existing PET programs. This program converts many of the memory addresses that differ between the two machines, but don't expect it to do much more than that. Graphics and machine language may give it problems.

One prematurely advertised option from another manufacturer is an emulator that would allow the

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Commodore 64 to load and run programs for the Apple II computer. Because the Apple II still has the largest collection of programs of any microcomputer in the world, such an emulator would be very desirable.

Developing this emulator may prove infeasible though. Emulators almost always run rather slowly because they have to translate instructions and simulate the workings of the original computer. For a simple BASIC program this is not difficult, but when you try to copy the complexities of the high-resolution graphics in a fast-moving game, you'll most likely end up with a very slow game that isn't fun to play.

The Commodore Information Network opens a new era in electronic publishing—it lets your computer get information about itself for little more than the price of a phone call.

The developers of the Apple emulator cartridge are unable to describe its features other than to say it will run "most" Apple programs. If you are interested in this product, be sure to test it extensively.

Documentation

Documentation for the 64 takes several forms, all of them quite good and some particularly innovative. The *Commodore 64 User's Guide* comes with the computer and provides a brief, friendly introduction to the 64 and its keyboard, BASIC programming, color and graphics commands, sprite graphics, music, and data handling. The small comb binding on the guide is a constant irritation as the pages jam and tear rather easily.

The early manual is also marred by numerous printing errors and changes, especially in the music section, but these should be corrected by now. Commodore acknowledged these errors with updates in both *Commodore* and *Power/Play* magazines (covering personal/business and home computing respectively) and in the Commodore Information Network. Publications devoted to specific computers are flourishing, and Commodore is wise to produce these two magazines providing ongoing information on applications, programming, games, and new products.

Using the computer to get information about itself via the Commodore Information Network opens a new era in electronic publishing. You can get hundreds of pages of information and programs for little more than the price of a phone call by connecting the 64 to the telephone with a VICmodem. The Commodore Information Network (part of Compuserve) is an electronic magazine that allows you not only to read, but also to leave messages on a bulletin board, ask questions on a hotline, submit articles or programs, and communicate with other Commodore users around the nation. The network also offers all programs printed in either of the two Commodore magazines, free public-domain software, and the Commodore program of the month.

The *Commodore 64 Programmer's Reference Guide* helps you to get far more out of the 64's built-in features by filling in many details that were left out of the simpler *Commodore 64 User's Guide.* If you want to know more about topics like programming the 64 in BASIC and machine language (the language of the 6510 microprocessor), medium- and high-resolution graphics, multicolor modes, scrolling the screen, multicolored sprites, multiple voices, and input to and output from all types of peripherals, then you'll appreciate this book. Just remember that it is a reference work, not a beginner's tutorial.

Having the computer teach you about itself is an added twist that's sure to captivate the novice. It's like having a friend sit down and show you all the features necessary to understand and operate the computer. The Commodore 64 Computer Tutorial, soon to be released, is an interactive program to introduce the keyboard and its various functions, to show the flexibility of the graphics and music in detail, and to explain BASIC, all at a gradual, easy-to-follow pace. This type of program has proven to be very effective and entertaining—one should be packaged with every computer sold.

Service

One of the major things wrong with the Commodore 64 is the track record of the company that manufactures it. Commodore has been criticized in the past for overemphasizing sales of equipment and not following up with the three S's: software, service, and support.

Times have changed from the days of the computer hobbyist; buyers now expect the same level of service for microcomputers that they get for televisions, stereos, and other consumer electronics. Commodore backs the 64 with a 90-day warranty, and dealers will exchange a defective computer for a new one within that period. After the warranty expires, you can send your Commodore 64 off to one of the two manufacturing plants for repair at a fixed price.

Conclusions

Like the original Volkswagen Beetle, the Commodore 64 offers a small initial investment, great economy, and inexpensive accessories. Not everyone will love the Commodore 64 for its design, but its price makes other computers look like gas guzzlers.

Its standard features will give the Commodore 64 a strong position in the coming years and probably renew the computer price wars. If you can live with its shortcomings, the Commodore 64 makes a great economy computer. Among low-cost color computers I consider it a best buy. □

Bear with us

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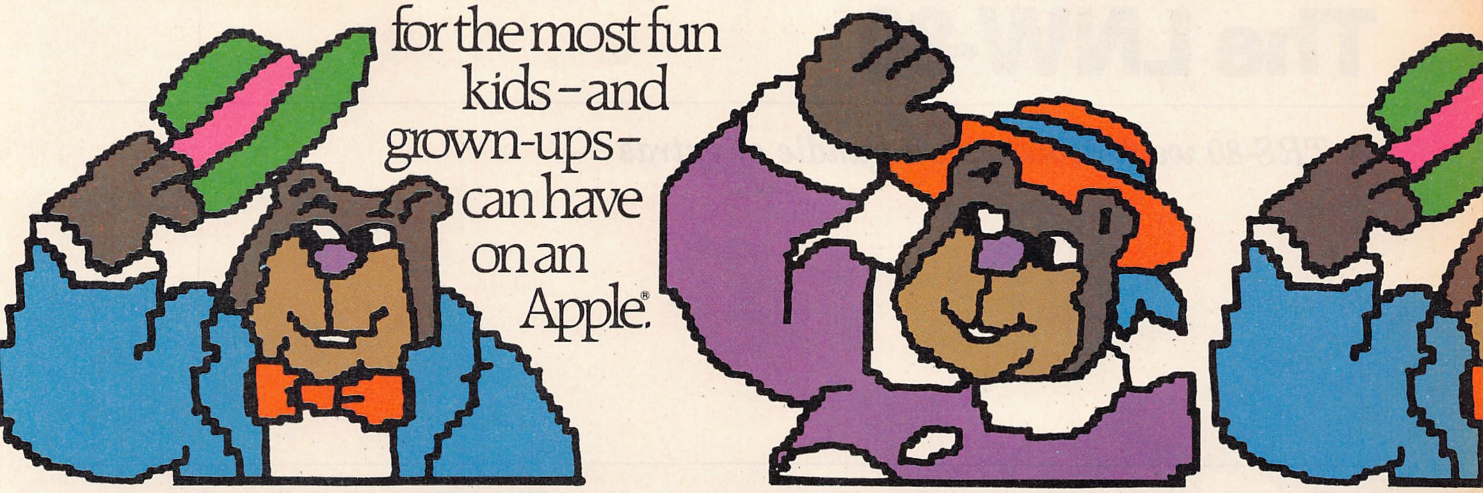

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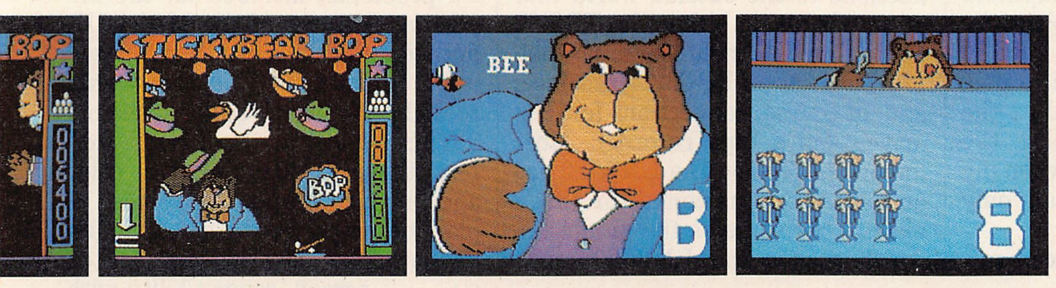
The answer is crystal clear when the whole family sits down to play Stickybear Bop, the action game with better than arcade-quality graphics that the three-year-olds can enjoy with grown-ups.



It's so simple even little kids can rack up big scores at the Stickybear Bop shooting galleries. And so exciting, the grown-ups will join right in on the thrills!

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STICKYBEAR
STICKYBEAR BOP
THE STICKYBEAR BOP GAME
HOW TO PLAY
STICKYBEAR

Apple II
and
Apple II Plus
48K 3.3 DOS

Developed by Optimum Resource, Inc.
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Xerox Education Publications
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Computer Software Division

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AM/MS7-PC

Circle 113 on inquiry card.

The LNW-80

A TRS-80 work-alike with a bundle of extras

by Mahlon Kelly

A few months ago my old and faithful TRS-80 Model I died. Although the machine had served me well, it was now far beyond repair—I had to replace it. I could opt for a completely different system, but then I'd have to throw away all my software. Or I could buy one of the computers designed specifically to replace the Model I, including the TRS-80 Model III, the PMC-80, the Lobo, and the LNW-80. I decided on the latter approach, and because the Lobo wasn't yet available when my machine died, I really had only three choices.

Still another problem faced me. Not only did I want all my software to work with the new machine, but I had special hardware designed to work with the Model I's expansion connector. That equipment was essential for my university research. Thus I ruled out the Model III because its expansion connector is completely different from the Model I's. Moreover, much of the software for the Model I—in particular, the disk operating systems—does not work with the Model III. And I also had a lot of data on disks that use a double-density Model I format, which a Model III can't easily read.

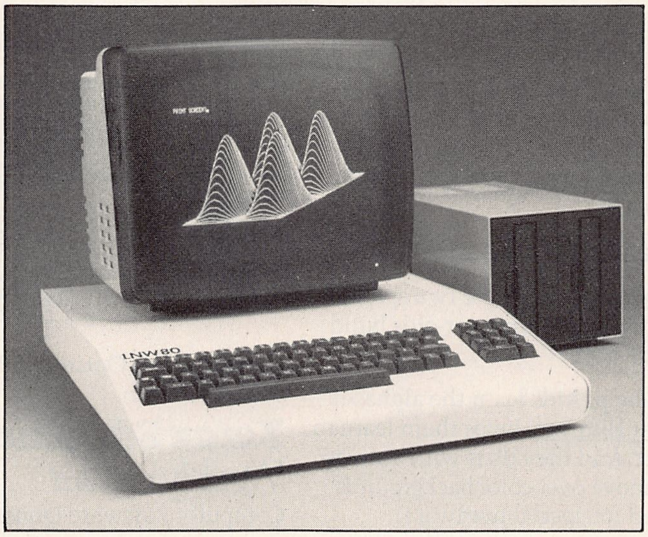
Next, I ruled out the PMC-80 because although it offers better compatibility with Model I software, it wouldn't work with my Model I hardware. My choice was clear: the LNW-80.

And a wise choice it's turned out to be. The LNW-80 has all the connections to the outside world that are available on either the TRS-80 Model I or III, including a parallel-printer port, an RS-232C interface, and, of course, connections for disk drives and a tape recorder. Most important for me, the LNW-80 has an expansion bus connector that's exactly the same as the Model I's, which makes the LNW-80 much easier to interface with custom-designed hardware and accessories.

I haven't found any significant hardware or software designed for the Model I that does not work with the LNW-80. In fact, the LNW-80 is more compatible with the Model I than is Radio Shack's Model III. It's cured all the Model I's problems, included all the important features of the Model III, and added even more capabilities.

In addition to its thoroughly tested design derived from the old TRS-80 Model I, the LNW-80 offers these enticing extras: color and high-resolution graphics, a plain but rugged case, an expanded keyboard, an 80- by 24-character screen, compatibility with all of the TRS-80 operating systems, single- and double-density disk storage on 5¼- or 8-inch disks, and high-speed operation. Options include CP/M compatibility and expanded memory.

The LNW-80, shown here with a monochrome monitor from BMC International and dual 5¼-inch floppy disks from Matchless Systems.



Hardware

The LNW-80's keyboard, processor, expansion board, and disk interface board—all cooled by an almost inaudible fan—reside in a large case that sits beneath the video monitor, which is housed in a separate unit. The case is 16½ by 22 by 3½ inches—in other words, it's big. It's made of heavy 16-gauge steel, spatter-painted in a cream color. No audio speaker is included; sounds are generated through the external video monitor.

The insides seem to be as rugged as the case. A friend of mine who designs marine navigation systems commented that the LNW-80 would survive combat on a battleship. Most components are soldered in place (soldered components can't work loose with vibration). All edge connectors are gold plated to prevent corrosion and the poor connections that caused so much unreliability with the Model I. Every component is top quality—for example, only the best brand-name chips are used. The power supply is much heavier than required, and because it has filtering and surge suppression, you shouldn't need a separate line filter.

All connections for disk drives, tape drives, a printer, and a modem come out the back of the machine. Connections include an RS-232C port (for hitching up to a modem or serial printer, for example), a Centronics-compatible printer port that works with almost all printers, and connectors for disk drives and a tape recorder. The LNW-80 can use 8-inch drives in addition to the 5¼-inch drives that the TRS-80 uses. The RS-232C works the same as that in the TRS-80 except that the data transmission rate is not software selectable; it can be specified only by a switch setting (although a modification available from other vendors can overcome this limitation). The connectors all have the same layout as those on the TRS-80, so you can use TRS-80 cables.

Like the keyboard of the early Model I, the LNW-80's keyboard has an excellent feel for the touch-typist. Its 73 keys include a numeric keypad, three user-definable keys, a cluster of arrows (to move the cursor), a control key, a mechanical shift-lock key, and two keys for reset. To prevent accidental resetting, the reset keys are located on opposite corners of the keyboard and must be pressed simultaneously.

The keyboard also has a key to select high- or low-speed operation. In low speed the machine operates at the same speed as the Model I (1.7 megahertz, or MHz); in high speed, the LNW-80 works at more than twice that speed (4.0 MHz). You're likely to use the low speed only while loading tapes made on a Model I or while running games or programs designed for the TRS-80 computers. The high speed halves disk access time and tape interaction, and some clever users have made modifications that let the LNW run even faster.

Although the LNW-80 does not include a monitor, the machine can use three types of monitors: black-and-white, composite-color, and RGB (red-green-blue). The same dot-resolution is available for each type, but an RGB monitor will give you the very best color picture, while a black-and-white monitor will be the least expensive. When purchasing a monitor for the LNW-80, be sure to consult with the dealer because not all models are compatible with the computer. I use an RGB monitor, so my comments relate to it.

Perhaps the best thing about the LNW-80 is its graphics. It offers four graphics modes. Mode 0 is the same as the TRS-80's video picture. Mode 1 is high-resolution black and white (see figure 1). It gives a resolution of 480 horizontal points by 192 vertical points, which is very respectable in comparison with much more expensive machines. You can superimpose mode 1 graphics on mode 0 low-resolution script and graphics. In addition, you can produce and erase graphics in either mode separately—it's almost like having two screens on top of each other. Mode 1 can also display an 80-character by 24-line screen, although you need special software supplied with the LNW to do so. With the right printer and an inexpensive program, you can print the high-resolution screen on paper (see figure 2).

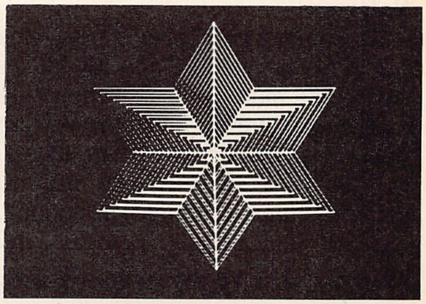


Figure 1: An example of mode 1 graphics.

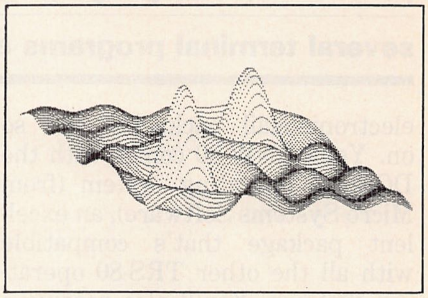


Figure 2: You can reproduce mode 1 graphics on paper by using optional software and a dot-addressable printer.

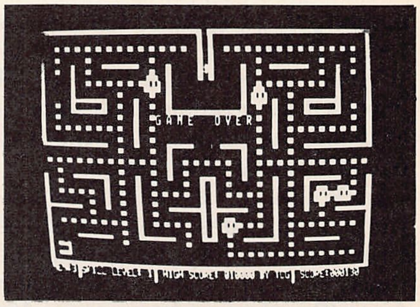


Figure 3: An example of mode 2 graphics which offers different zones of low-resolution color.

Mode 2 is low-resolution color. It supports 8 colors and a graphics resolution of 127 horizontal points by 192 vertical points. The screen can be partitioned into different color zones, making it very easy to duplicate some of the popular video games (see figure 3).

Mode 3 graphics offers the color choice of mode 2 and the high-resolution of mode 1. The disadvantage is that you can't superimpose normal text.

Mahlon Kelly is a writer and university professor living in Charlottesville, Virginia.

Software

As mentioned previously, the LNW-80 can use all the Model I's software: more than 10 operating systems, several word-processing packages, more than 8 languages, at least 4 BASIC compilers, several smart-terminal programs, electronic-mail packages, and so on. Your LNW-80 comes with the DOSplus operating system (from Micro-Systems Software), an excellent package that's compatible with all the other TRS-80 operating systems. You'll also receive a graphics-oriented BASIC (LNW BASIC, written by Modular Software Associates) and several input/output programs that allow screen formats of 80 characters by 16 lines or 80 characters by 24 lines. Other graphics software is available, and more is on the way from a variety of suppliers.

More than 10 operating systems, several word processors, 8 languages, 4 BASIC compilers, and several terminal programs are available for the LNW-80.

LNW BASIC is the critical software: it provides easy use of the graphics capability along with the functions that other BASICs perform. (See the text box on page 182 for a summary of LNW BASIC's features.)

If all of LNW BASIC is in memory at one time, not much space is left for programs. The program called Creator overcomes this problem. Creator lets you specify which features you'll need for a particular BASIC program. Because even a long program will probably need only a few of the new statements, you can create a module that has just the necessary statements and uses little memory.

LNW BASIC graphics commands are similar to those used in TRS-80 Color Computer BASIC. MODE sets the graphics mode; for example, MODE 1 sets high-resolution black and white. PSET *x,y* produces a point at a specified coordinate. PRESET *x,y* erases the point. LINE draws a line from one point to another, erases a line, or draws a box, depending on how you use the command's options. DRAW uses a set of directions specified in a string to draw a complex shape.

COLOR in mode 2 specifies the foreground color to be used in subsequent graphics commands. CIRCLE creates circles, arcs, ellipses, or parts of ellipses and makes it easy to produce pie diagrams. PCLS in mode 1 simply erases the graphics display; in mode 2 it specifies the color background. Thus you can have a green, amber, or blue screen very simply.

Perhaps the most important statements are PSAVE and PLOAD. PSAVE saves the graphics screen to disk. PLOAD puts it back on the screen. By using these commands you can produce a complex display or graph and save it to disk memory to be recalled later. By the way, you can use optional software to send any mode 1 display to a dot-addressable printer for a hard copy.

Other parts of LNW BASIC are equally useful. For example, one option lets you set any key to produce a BASIC command, allowing single-key input while programming. DEFKEY lets you assign a command or message to a single key, thus letting you change ordinary keys into user-definable keys. SOUND sends a tone of specified frequency, duration, and waveform out through the monitor's speaker. You can send video output to either the printer or disk; in the latter case, you can send the output to the printer later to speed up printing.

One of the more powerful statements in LNW BASIC is XSTR$. The statement takes a string input and executes it as if the string itself were included in the program. The following program

At a Glance

Name: LNW-80 microcomputer

Uses
Anything requiring a general-purpose microcomputer with both TRS-80 and CP/M compatibility and high-resolution and color graphics

Manufacturer
LNW Research Corporation
2620 Walnut
Tustin, CA 92680
(714) 544-5744

Standard Features
Z80 machine with 73-key keyboard with numeric keypad, 48K bytes of RAM (random-access memory), RS-232C interface, parallel-printer interface, disk-controller interface, complete compatibility with TRS-80 Model I software and hardware, high-resolution black-and-white and color graphics, high-speed operation, rugged case

Options
CP/M and extra bank-selected memory

Software
Provided with purchase: Microsoft BASIC in read-only memory (TRS-80 compatible), DOSplus operating system, LNW BASIC with high-resolution and color graphics support, and 80- by 16- and 80- by 24-character input/output programs. Other graphics packages available. Operates with any TRS-80 Model I-compatible software and, as an option, with CP/M-compatible software

Accessories
Anything that works with the TRS-80 Model I

Documentation
Users manual, technical manual, DOSplus manual, Level II BASIC manual, LNW BASIC manual

Typical System Accessories
Disk drives, printer, video monitor

Base List Price
$1695

System List Price
$2744 with monochrome monitor and dual 5¼-inch disk drives

Timex/Sinclair 1000

Sinclair ZX-81

Super-Market

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16 RAM PACK $39.95

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data~assette

POC-5

Circle 123 on inquiry card.

demonstrates its use:

```
10 PRINT "TYPE IN ANY BASIC
   STATEMENT"
20 INPUT A$
30 XSTR$(A$)
```

The program would first prompt you to type in a BASIC statement. Suppose you typed "PRINT 3/7". The program would execute that statement just as if it had been included in the program, printing the value of the expression 3/7.

By the time you read this review, a new version of LNW BASIC should be available. It promises much faster graphics plotting and support of high-resolution color for those who own an RGB monitor. The new version will be available for a nominal charge from LNW.

Documentation

LNW supplies five manuals with the computer, and they're the best available. The TRS-80 Level II BASIC manual is outstanding, as is the DOSplus manual. Equally good is the LNW BASIC manual, which uses simple explanations and many examples. And LNW hired IJG Inc., a publishing company in Upland, California, to produce the users manual and technical manual. IJG has produced what are recognized as about the best books on the operation of TRS-80s. Although learning to operate the LNW-80 takes work, the documentation should ease the task.

I must also mention the LNW-based computerized bulletin boards and newsletters. At present, at least two of each are available. The bulletin boards can be reached at (516) 924-8115 and (504) 291-4331. The former works at either 1200 or 300 bits per second (bps); the latter operates at 300 bps. Both bulletin boards are a source of valuable software.

Newsletters are published by Jim Edwardson, Rt. 1, Box 244, Yaphank, NY 11980 and by Jay Hockanson, 4345 Manchester Rd., Grand Island, NE 68801. Although primarily intended for kit builders (LNW has produced computer kits since 1978), the newsletters contain information that any LNW-80 owner will find helpful.

Conclusions

My only complaints about the LNW concern the case and keyboard, and those complaints are minor. Early cases often rusted, but newer ones are made of plated steel. Still, the ivory paint wears off and is easily stained. Like the keyboard on the original TRS-80, the LNW-80's keyboard sometimes prints double characters while you're typing, but that's corrected by any of the popular operating systems. Finally, I would have appreciated a detachable keyboard.

All in all, the LNW-80 is an excellent machine. It provides high-resolution and color graphics, high-speed operation, an 80-character by 24-line screen, heavy-duty construction, outstanding software, and compatibility with a huge library of software. Although the LNW-80 may have begun life as a TRS-80 imitator, it's certainly well able to stand on its own. □

A Summary of LNW BASIC Commands and Statements

BLINK—Switch blinking cursor on and off
CALL *address*—Execute a machine-language program
CIRCLE—Produce a circle, ellipse, or arc
COLOR—Specify the color of the next graphics command
CONV—Convert between various hexadecimal and decimal expressions
DEFKEY—Define a string assigned to a key
DISKEY—Show the defined keys
DLOAD *file*—Load a machine-language program
DO . . . UNTIL—Do a loop until a condition is met
DRAW *string*—Draw a figure specified by *string*
DRUN—Exit LNW BASIC and run a command-level program
EXIT—Return to the operating-system mode
FLS—Fill the screen with a character or color
GSUB *name*—Go to a named subroutine or to a numbered subroutine
GTO—Branch to a named routine or a numbered routine
HIMEM—Set the high-memory limit
LCASE—Switch lowercase on or off
LINE—Draw a line between specified points
LOADKEY—Load a file of defined keys
LOC—Locate a string in the program text
MODE—Set the graphics mode
NTROFF—Turn off the enhanced trace facility
NTRON—Turn on the enhanced trace facility
PCLS—Clear the graphics memory or fill it with a specified color or value
PLOAD—Load the graphics memory from a disk file
POFF—Turn off the echo from video to printer
PON—Turn on the echo from video to printer
PRESET—Erase a specified pixel or point
PSET—Turn on a specified pixel or point
PSAVE *file*—Save the high-resolution screen to a disk file
QUICKEY—Switch the abbreviated key entry on and off
REPEAT—Switch the keyboard repeat and beep on and off
REST—Restore a data pointer to the start of a line
RS232—Initialize the RS-232C interface
RSIN—Turn on (or off) input from the RS-232C interface
RSOUT—Turn on (or off) output from the RS-232C interface
SAVEKEY *file*—Save defined keys to a disk file
SOUND—Produce a tone of specified pitch, character, and duration
SPOOLOFF—Turn off spooling of printer output
SPOOLON—Turn on spooling of printer output
XSTR$(*string*)—Execute a string as a BASIC statement (see text)

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1600
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256 LEVELS OF SKILL
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AMOK
ALIEN BLITZ
1619
10 LEVELS OF SKILL
AMOK
GAME CARTRIDGE FOR THE COMMODORE VIC 20
9 LEVELS OF SKILL
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1611
METEOR RUN
GAME CARTRIDGE FOR THE COMMODORE VIC 20
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JOYSTICK ACTION
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RANDOM ACCESS

A wide-ranging look at ways to get more from your personal computer

Persuing the Ultimate Sports Statistic Page 184
An Inexpensive Paper Tray Page 190
The Smalltalk-80 System Page 192
When Your Computer Breaks Down Page 196
Surviving a Trip to the Computer Store Page 200

Chicago
40
Chicago
CELTICS
33

By any measure Larry Bird is the most productive Celtic.

Persuing the Ultimate Sports Statistic

Q. What do beer, strong lungs, and Visicalc have in common?

A. They are all key possessions of the truly modern sports fan.

The beer needs no explanation.

Strong lungs? Modern sports fans are like medieval theologians. They love to argue interminably over theoretical questions. Indeed, skill in concocting the questions may be prized over skill in answering them. And arguing whether the 1955 Mickey Mantle Yankees could beat the 1975 Johnny Bench Reds sometimes seems at least as important as, and far more pleasant than, arguing over the reason for high interest rates.

And Visicalc? Consider that the final characteristic of fanaticism is an insatiable hunger for records and statistics.

Sports record-keeping has become big business. League offices, teams, and even sports writers are keeping track of a wide variety of records and statistics. The more forward-looking of these statisticians, of course, are using their computers.

Once a sports fan becomes as comfortable with his electronic spreadsheet as he is with his paper and pencil, however, he will quickly tire of the pedestrian records kept by most leagues. Clearly, the variety of statistics has grown over the years in response to fans' growing appetites for such information. The subtleties of statistics, however, are limited only by the individual fan's sophistication in using his computer.

The individual computer owner is limited in record-keeping only by access to the raw data, patience in inputting the data, and the imagination applied in manipulating the data. The example below is actually very simple. (The entire process from turning on the computer to getting the final printout took less than an hour.)

The *Popular Computing* offices are located in southwestern New Hampshire, within the home-town-fan sphere of Boston. Personal interest thus led to the use of the final 1981-1982 season statistics for the Boston Celtics. This information is printed in the local newspapers at the end of the season and

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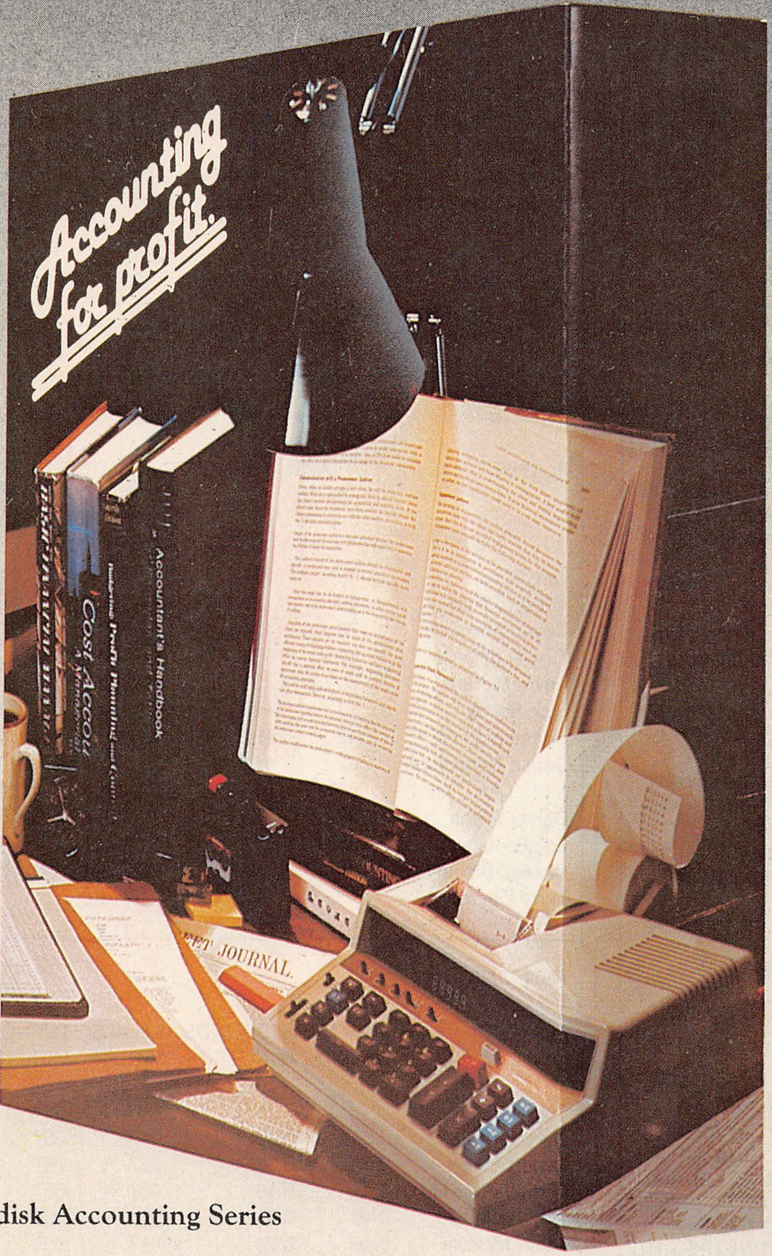

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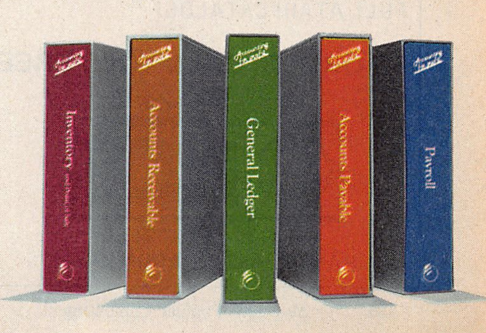

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Table 1a

PLAYER	MINUTES PLAYED	FIELD GOALS MADE	FIELD GOAL ATTEMPTS	FIELD GOAL %	TOTAL REBOUNDS	TOTAL ASSISTS
Larry Bird	2923	711	1414	.503	837	447
Robert Parish	2534	669	1235	.542	866	140
Cedric Maxwell	2590	397	724	.548	499	183
Tiny Archibald	2167	308	652	.472	116	541
Kevin McHale	2332	465	875	.531	556	91
Rick Robey	1186	185	375	.493	295	68
Chris Ford	1591	188	450	.418	108	142
Gerald Henderson	1844	353	705	.501	152	252
M. L. Carr	1296	184	409	.450	150	128
Danny Ainge	564	79	221	.357	56	87
Eric Fernsten	202	19	49	.388	42	8
Charles Bradley	339	55	122	.451	38	22
Terry Duerod	146	34	77	.442	15	12

Table 1b

PLAYER	STEALS	TURNOVERS	BLOCKED SHOTS	TOTAL POINTS	AVERAGE POINTS/ GAME	SEASON HIGH
Larry Bird	143	254	66	1761	22.87	40
Robert Parish	68	221	192	1590	19.88	37
Cedric Maxwell	79	174	49	1151	14.76	31
Tiny Archibald	52	178	3	858	12.62	26
Kevin McHale	30	137	185	1117	13.62	28
Rick Robey	27	92	14	454	5.68	15
Chris Ford	42	52	10	435	5.72	15
Gerald Henderson	82	150	11	833	10.16	27
M. L. Carr	67	63	21	455	8.13	22
Danny Ainge	37	53	3	219	4.13	17
Eric Fernsten	5	13	7	57	1.33	6
Charles Bradley	14	37	6	152	2.98	10
Terry Duerod	3	2	1	72	3.43	12

Table 2

PLAYER	POINTS/ MINUTE	REBOUNDS/ MINUTE	STEALS/ MINUTE	TURNOVERS/ MINUTE	PERSONAL FOULS/ MINUTE	BLOCKED SHOTS/ MINUTE
Larry Bird	0.60	0.29	.049	.087	.083	.023
Robert Parish	0.63	0.34	.027	.087	.105	.076
Cedric Maxwell	0.44	0.19	.031	.067	.102	.019
Tiny Archibald	0.40	0.05	.024	.082	.060	.001
Kevin McHale	0.48	0.24	.013	.059	.113	.079
Rick Robey	0.38	0.25	.023	.078	.154	.012
Chris Ford	0.27	0.07	.026	.033	.090	.006
Gerald Henderson	0.45	0.08	.044	.081	.108	.006
M. L. Carr	0.35	0.12	.052	.049	.105	.016
Danny Ainge	0.39	0.10	.066	.094	.152	.005
Eric Fernsten	0.28	0.21	.025	.064	.114	.035
Charles Bradley	0.45	0.11	.041	.109	.180	.018
Terry Duerod	0.49	0.10	.021	.014	.062	.007

is also available from the league and team offices. The data actually used was obtained from the Celtics 1982-1983 Media Guide. A condensed version of the statistics appears in tables 1a and 1b.

While this data provides much food for thought, with your trusty computer at hand it is simply an ingredient of a great feast for compufan.

Using Visicalc

A database management system could be used to store the information and then sort through entries on the basis of the desired statistic. On the other hand, a very simple and effective approach is simply to use Visicalc or another of the many electronic spreadsheet programs. Without any attempt to analyze which computer and which software would be best for this particular task, I used a TRS-80 Model II and Visicalc simply because they happened to be handy at the time I had the idea.

After entering the data shown in tables 1a and 1b onto the electronic spreadsheet, I immediately saw that more refined statistics could easily be generated. For example, knowing the number of minutes each player played as well as the major statistical categories (e.g., points, rebounds, assists, etc.), I simply defined new columns by dividing the raw-number statistical totals by the number of minutes played. Once the data was into the Visicalc program, this redefinition and generation of additional columns took a matter of seconds.

My instant gratification was the data shown in table 2. This analysis already begins to yield some finer details about the performance of the players. For example, while Danny Ainge ranked eighth in total steals for the year (table 1b), he ranked first in steals per minute (table 2).

After studying the results of these Visicalculations, I realized that an overall measure of the player's performance could be created by merging the newly gen-

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Table 3

PLAYER	POINTS PER GAME	EFFICIENCY RATING
Larry Bird	22.87	1.026
Robert Parish	19.88	1.040
Cedric Maxwell	14.76	.690
Tiny Archibald	12.62	.642
Kevin McHale	13.62	.790
Rick Robey	5.68	.646
Chris Ford	5.72	.431
Gerald Henderson	10.16	.640
M. L. Carr	8.13	.585
Danny Ainge	4.13	.619
Eric Fernsten	1.33	.525
Charles Bradley	2.98	.575
Terry Duerod	3.43	.692

Table 4

POINTS PER GAME	EFFICIENCY RATING
1. Larry Bird	1. Robert Parish
2. Robert Parish	2. Larry Bird
3. Cedric Maxwell	3. Kevin McHale
4. Kevin McHale	4. Terry Duerod
5. Tiny Archibald	5. Cedric Maxwell
6. Gerald Henderson	6. Rick Robey
7. M. L. Carr	7. Tiny Archibald
8. Chris Ford	8. Gerald Henderson
9. Rick Robey	9. Danny Ainge
10. Danny Ainge	10. M. L. Carr
11. Terry Duerod	11. Charles Bradley
12. Charles Bradley	12. Eric Fernsten
13. Eric Fernsten	13. Chris Ford

Table 5

PLAYER	RATIO FREE-THROW TO FIELD-GOAL POINTS
Larry Bird	.231
Robert Parish	.188
Cedric Maxwell	.450
Tiny Archibald	.383
Kevin McHale	.201
Rick Robey	.227
Chris Ford	.104
Gerald Henderson	.177
M. L. Carr	.223
Danny Ainge	.354
Eric Fernsten	.500
Charles Bradley	.382
Terry Duerod	.059

Table 6

PLAYER	POINTS PER GAME PER INCH OF HEIGHT	SEASON REBOUNDS PER INCH OF HEIGHT
Larry Bird	.282	10.33
Robert Parish	.235	10.25
Cedric Maxwell	.184	6.24
Tiny Archibald	.175	1.61
Kevin McHale	.164	6.70
Rick Robey	.068	3.55
Chris Ford	.074	1.40
Gerald Henderson	.137	2.05
M. L. Carr	.104	1.92
Danny Ainge	.054	0.73
Eric Fernsten	.016	0.50
Charles Bradley	.039	0.49
Terry Duerod	.046	0.20

erated figures. Thus, assuming (as a first approximation) that points, rebounds, steals, and blocked shots all contribute equally to a team's success and that turnovers detract, I simply defined a new column that added and subtracted the relevant figures to come up with what I then called an *efficiency rating*. The result is shown in table 3.

In table 4, the 1981-1982 Celtics are ranked according to points per game (the NBA ranking) and according to the efficiency ratings of table 3. Because this is an article about using computers and not about professional basketball, I won't go into this fan's view of the implications behind the shift of every player's position between the two columns of table 4.

All of this was so quick and easy that my imagination shifted gears. With my computer ready, willing, and able to make any calculation faster than I can think of it, all kinds of crazy ideas came to mind.

Thus, table 5 shows my next idea: the ratio of free-throw points to field-goal points. Arguably, the players who can shoot in heavy traffic, and thereby pick up free throws too, contribute beyond the guys who can score if left alone.

Surely, I argued persuasively to myself, height ought to be an advantage in both scoring and rebounding. After all, I once found a playground with an 8-foot basket and broke all kinds of personal records. (I've got rim scars on my knuckles to prove it.) As fast as my limited typing skills could enter the Visicalc commands, I had generated table 6 in an effort to nullify height advantage in comparing scoring and rebounding.

By now my mind was racing. I could combine any of the items of original data with my calculations so far. Field goals plus rebounds plus one half of the assists, all per turnover? Piece of caaaaa—

The can of beer that I knocked onto the keyboard stood me a substantial repair bill and brought to a screeching halt the roll I was on that night. Hey, but I've learned. Beer *then* statistics. Not beer *and* statistics. —Gordon R. Williamson

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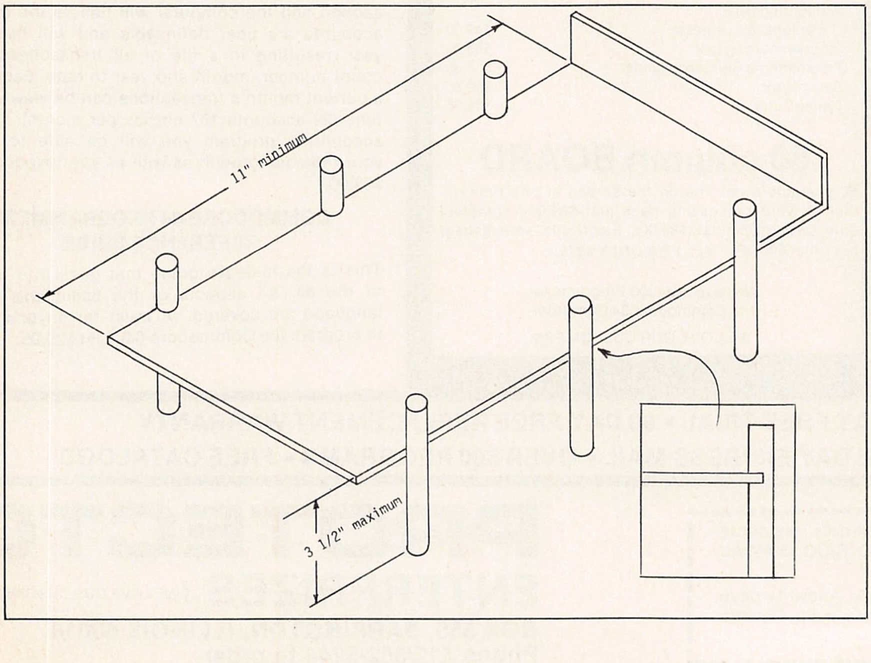
An Inexpensive Paper Tray

As I'm sure is the case with many home computer users, my computer work area is not spacious enough to allow unattended feeding and gathering of the paper that runs through my Epson MX-80 printer. Because commercially available paper trays were either too big or too expensive, I decided to construct a simple tray of my own design. My first attempt had a few bugs to work out, but the tray described here fills the bill for my MX-80 and could easily be adapted to other printers.

Ideally, the printer's paper supply sits on the floor. The paper comes up from the floor, through the printer, and stacks in a tray or bin. My situation was far from ideal, though. I had to stack the paper supply on my desk and, even worse, fold the output back and collect it on top of the printer. This inadequate system required constant attention to ensure proper feeding and stacking of the paper.

After several imperfect initial designs, I was able to devise a satisfactory solution (see illustration). Tractor-feed paper measures 9½ by 11 inches, including the tractor-feed holes that are later torn off. These dimensions set the minimum size of the paper tray. The tray itself is a flat piece of 1/8-inch-thick acrylic plastic supported by four or six 5-inch legs made of thin-wall polyvinyl chloride (PVC) pipe. The acrylic sheet's *minimum* dimensions are 10 by 11 inches. However, more ideal dimensions are 10½ by 12 inches. The extra width lets you insert the sheet of plastic into slots cut in the PVC legs, thus creating the basic joints that hold the unit together. When the sheet of plastic is glued into the slots on the legs, there must be enough room left to prevent the paper's binding on the parts of the legs that rise above the tray.

The dimensions of the MX-80 dictate the 3½-inch height of the tray, which must be slightly lower than the printer's paper separator to ensure proper folding of the output. The tray should be longer than the paper so that you can position it under the end of the separator.



However, the power cord and the computer-printer interface cable can cause problems. If the computer happens to be an IBM PC, the very bulky connector and the inflexible cable require a lot of room because it is impossible to make a sharp bend in the cable. The Apple II interface cable, on the other hand, is very flexible, and it's easy to bend it sharply. In addition, the Apple's connector is smaller than the IBM's. The interface cable's flexibility and the connector's size control how close the tray can be placed to the printer and in turn dictate the length you should cut the plastic tray.

Make It Yourself

On the end of the tray away from the printer, glue a piece of plastic about 1½ to 2 inches high and 6 to 8 inches long. This serves as a stop to prevent the paper from running off the end of the tray, causing it instead to fold and stack neatly as it is fed out of the printer.

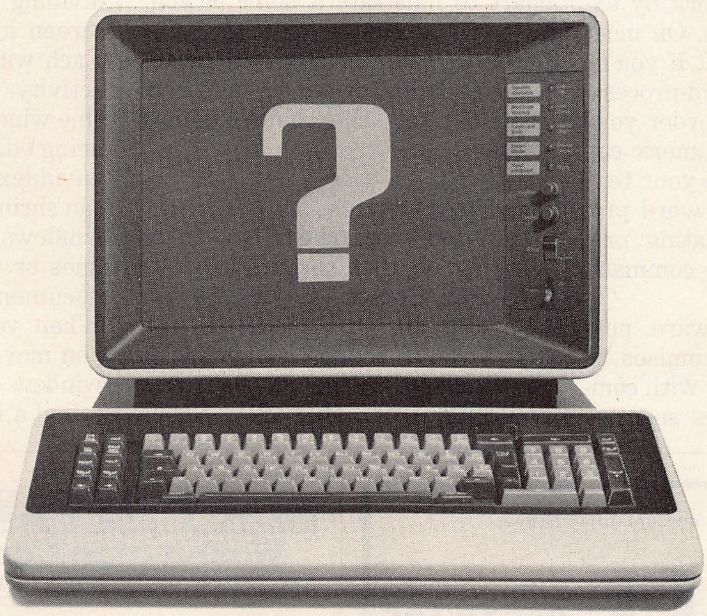
The 1½-inch pieces of the legs that protrude above the sheet plastic serve as guides for the paper as it comes out of the printer and into the tray. Although there is no practical limit to the height the PVC legs rise above the tray, use has shown that 1½ to 2 inches is more than adequate. All parts are bonded together with acrylic plastic cement.

The paper supply is placed under the tray, thus limiting you to a stack about 3 inches high—adequate for at least one evening. As with any such system, you should check to see that the first couple of sheets feed and fold smoothly, but after that you can relax or work on something else.

Feel free to use the design as is or modify it to suit your particular needs. The materials are inexpensive, and assembly is quick, easy, and even fun. This sort of project gets the computer hacker away from the machine and into the workshop for a change, and there is something to show for the effort.

—William L. Shelton

How to keep your smart computer from turning dumb.



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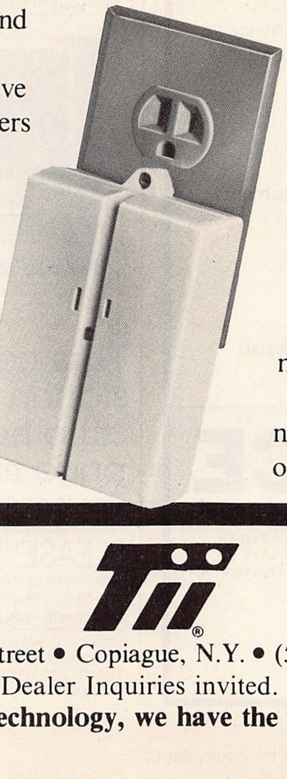

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The Smalltalk-80 System

If you've had any experience working with computers, you've probably stubbed your toe on a *mode*. A mode is an arena of operations, a name for what your computer's doing. Modes work by excluding other operations. On most systems, this means that if you're editing text with a word-processing program, you can't order your machine to do a quick numeric calculation unless you save your text on disk, exit from your word processor, call up a calculating program, and then give the command for the calculation.

A new kind of software now reaching the market promises to greatly simplify working with computers by making modes seem to disappear. The goal of such *modeless operation* is to place all the capabilities of the computer only a few keystrokes away. If in such a system you want to design a bar chart to illustrate a point in your text, you'd simply give the computer a couple of straightforward commands and it would take care of most of the housekeeping details.

Academic Origins

A dozen researchers have been working at the Xerox Palo Alto Research Center (PARC) for the last 10 years on a modeless software programming system called Smalltalk-80. Although just now emerging from the labs, Smalltalk-80 may be the key that unlocks the potential of the emerging generation of powerful microprocessors such as the Intel 8086 and the Motorola 68000. Often referred to as computer languages, Smalltalk-80 and similar systems are actually programming *environments* containing a language and other programming utilities.

Smalltalk-80 gets rid of modes by dividing the computer's display screen into boxes called *windows*. Each window opens on a different activity (or, in the old style, mode). One window might display a report being edited while another could be an index of related reports. You can shrink or expand the size of the windows, displaying just a few lines or the entire contents of the document you're working on. When you want to switch tasks, you move the cursor to a different window using a control device called a *mouse*.

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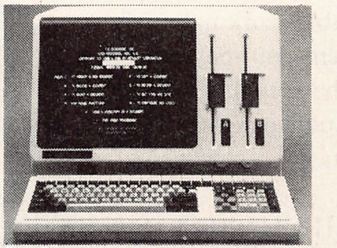

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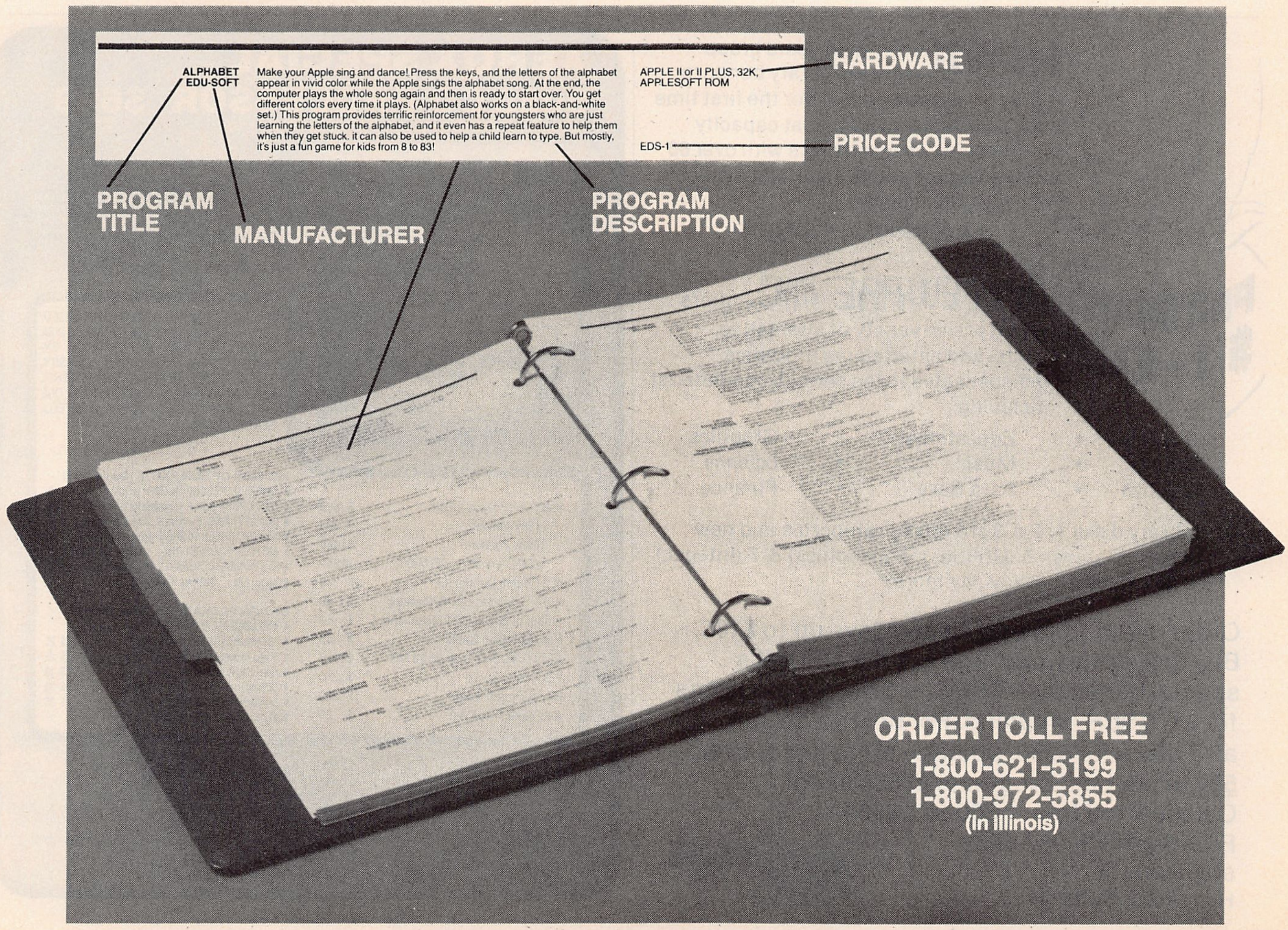

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The mouse is a small box sized to fit comfortably in your hand and connected to the computer by a thin cord (the mouse's tail). When you slide it across a flat surface, sensors on the underside of the mouse detect the movement and send that information to the controlling software, which in turn moves the cursor. Buttons on the top of the mouse let you "talk" to the Smalltalk-80 system, expand and reduce windows, move text, or choose options from a menu.

Smalltalk-80 keeps all of this visual information from becoming confusing by presenting it in extremely high resolution on black-and-white monitors, giving the effect of text in a glossy magazine. This high resolution, when coupled with the capabilities of Smalltalk-80, offers exciting possibilities for graphics; in fact, PARC researchers have put together a graphics-editing program that can produce images rivaling pen-and-ink drawings.

Power to the People

The external features of Smalltalk-80—the windows, the modeless operation, the mouse, and the high-level graphics—are part of what software designers call the *user interface*. Computer users who want these features (mouse, windows, and so forth) but don't need the extra programming capabilities of the Smalltalk-80 system can find many of them on the Xerox Star, a business computer that comes with a 10-megabyte hard-disk drive and retails for about $16,000. Apple Computer's new Lisa also offers many of the same features for a complete system price of under $10,000. Neither of these business systems presently provides a Smalltalk-80 programming environment, however.

No one at Xerox seems to remember exactly where the name Smalltalk came from, but researcher Daniel Ingalls likes to think of it as a "system built with a small number of concepts." For the computer programmer, those concepts can mean liberation from housekeeping details such as memory management. For the home computer user, they may ultimately mean the emergence of programs in easily-customized kit form.

As of last winter, Xerox was offering the Smalltalk-80 language and program development system on its scientific workstation computer known as the Xerox 1100, which sells for $45,000, and had plans to offer it on the Xerox 1132 at a package price of $179,000. Apple Computer Inc., which holds a license from Xerox to market Smalltalk-80, is planning to offer it at a more affordable price on its new Lisa, but complete pricing details are not available.

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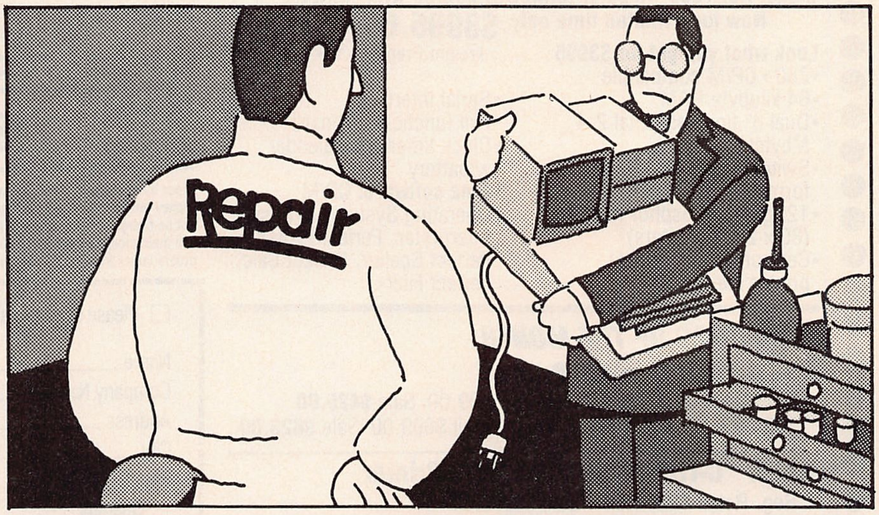
Apple software engineer Larry Tesler notes that his firm's version of Smalltalk-80 will be purely a program development system, offered in the expectation that independent vendors will develop applications for Apple machines. Smalltalk-80 program kits are probably still a year or more away.

Xerox has announced no definite plans to offer Smalltalk-80 on its Xerox Star, but industry observers agree that the Star's microcode design makes a Smalltalk option very feasible. Digital Equipment Corporation, Hewlett-Packard, and Tektronix are three other manufacturers holding licenses to market Smalltalk-80, but none would discuss marketing intentions when this column went to press.

Because its breadth and sophistication require a large internal memory and a very fast processor, Smalltalk-80 will probably be available only in the high-priced end of the microcomputer market for some time. But that very sophistication may bring it to the fore as hardware prices continue to fall. As Xerox's Ingalls points out, "Smalltalk-80 is future-oriented. If your computer were 10 times more powerful, you couldn't do much more with Pascal or FORTRAN, but you could really exploit that power with Smalltalk."

—Dara Pearlman



When Your Computer Breaks Down

It is a fact of life that computers break down. They are only plastic, metal, and silicon, and they're made by people who worry about bills, suffer from the flu, or become otherwise distracted. For your own well-being and that of your computer, you should know exactly how you will get your system repaired and what steps you should take to prevent as many problems as possible.

Knowing your repair options is essential for full satisfaction from your new machine. If retailers glide over the question with "Don't worry, we offer full service," find out specifically what they mean. Some computer dealers may not want to broach the subject of com-

Illustration by Patrick Blackwell

puter repair first. That puts the ball in your court. Ask questions. How long will repairs take? How much will they cost? How convenient will they be?

But let's assume you just walked out of the retailer's door. If you bought your new system from a major manufacturer, you probably have a 90-day warranty. (Lower-priced demonstration models may or may not have warranties.) This warranty means that if anything goes wrong during those 90 days, the manufacturer will pay for it. If there are recurring problems during the warranty period, notify your dealer in writing. Most dealers will continue to absorb the cost of repairs for problems that began before the warranty expired. Others may simply replace the faulty equipment and extend a warranty for a replaced piece of equipment so the new hardware can be fully tested.

Service Contracts

After the warranty expires, you can buy a service contract or extended warranty, or you can rely on finding service as you need it.

Service contracts and extended warranties are basically the same thing, but the details of the contracts may vary depending on what you need and how much you're willing to pay. The most expensive contract provides on-site service. This means someone arrives at your door (usually within 24 hours) to remedy the problem. The fee for these contracts averages 1 to 1½ percent of your system's cost. The charge is calculated monthly, and you are billed once a year. If you can't afford to have your system down for very long and you can afford the expense of this type of contract, on-site service may be the route to take.

Less expensive contracts may require you to bring the malfunctioning hardware to a service center. You still receive priority treatment over those with no contracts, but this sort of contract will definitely require more of your time. It also

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Circle 7 on inquiry card.

may be inconvenient to get to the service center.

Having a service contract means you never have to pay a large amount of money at any one time. When the computer goes on the blink, you simply call the repair office, and the computer is fixed at no additional cost to you. The fees for these types of contracts can be built into the total bill if you are financing your purchase.

If you do not take a service contract or extended warranty, you'll have to rely on in-store, per-call service. This may mean paying a very high hourly rate in addition to the cost of parts. Usually a minimum of one or two hours is billed, and hourly rates can run between $40 and $65. Those dealers accustomed to working with small businesses may also provide on-site, per-call service, but this will be even more expensive. More important, as a per-call customer, you are last in line behind customers with service contracts.

The least attractive but occasionally unavoidable option is to ship equipment out for repairs. Not only is this type of service time-consuming and irritating, it won't necessarily save you any money. In fact, it may even cost you more because of shipping charges. Repairs and shipping time could run several weeks or more, compared to the several days it would take at a local service center. Because this may become necessary, however, you should save your system's original packaging.

Reducing Repair Costs

Ultimately, what you decide to do will depend on how much you are willing to pay, how much you use your system, and how long you are willing to wait while your computer is being repaired. Don't be pressured into a service contract that is more than you believe you'll ever need. Use foresight when buying a computer: know what you'll do if your computer needs to be fixed and be prepared to budget some money for maintenance.

Being aware of repair service options is essential. But avoiding service problems by taking care of your computer is the best way to ensure good, consistent performance and, perhaps, save money.

The elements of the computer that are most likely to fail are the mechanical ones. Disk drives and printers are the most prone to problems; keeping them free of dirt and dust is a must.

You should use a cleaning disk regularly to clean your drive's read/write head. But remember, if used improperly, a cleaning disk can damage the alignment of disk heads. Also, use only top-quality disks; their magnetic surface is less prone to flaking, and their envelopes are designed to clean the disk as it rotates.

Always handle disks with care—many problems that appear to be in the drive are actually the result of careless handling of the disks themselves. Never write on a disk or its label. Fill out labels, *then* stick them onto the disks. Store disks in their envelopes or use a disk-filing system to keep disks clean and safe. And never place a disk by anything magnetic, such as a telephone. Last, purchase line filters to protect your disks against power surges that can erase the disk's storage or blow a chip. When electronic glitches crop up on otherwise good software, they're usually caused by improper procedures or dust.

If a chip does fail, it will rarely cause an entire circuit board to fail. However, technicians usually replace the entire board to repair it. You should be reimbursed ultimately for part of the cost of the new board depending on what can be salvaged from your original circuit board. This is generally called the *swap cost.*

Don't be penny-wise and pound-foolish by trying to stretch the life of your printer's ribbon. When a ribbon frays, the particles may damage the print head. You should also take the printer to a service center annually for a thorough cleaning and checkup.

Always use dustcovers to protect the entire system against dust. Otherwise, dust will enter through the air vents and cause problems. Dustcovers cost anywhere from $12 for a single cover to $80 for covers for a multipiece system, but that is a lot less expensive than a single repair call. Antistatic cleaning fluid and a soft, clean cloth are also effective in keeping the video screen free of dust and static that may interfere with operation.

Although cables and connectors usually work as advertised, you should handle all connections with care. Don't force them. A bent pin is easily straightened, but a broken pin usually means replacement of the entire connector. Flat ribbon cables are not shielded against radio-frequency interference (RFI), so be sure yours are not encountering anything that could interfere with them.

Electronic failures are often caused by heat. When setting up your system, make sure that vents are not blocked and that your computer is not sitting by a heat source.

Above All, Stay Calm

When something does go wrong, don't panic. Make sure you are doing everything properly. Then call the dealer or manufacturer (many have toll-free hotlines). Explain the problem clearly and in detail. Most technicians agree that repairing a microcomputer is easy and quick; the difficult and time-consuming task is diagnosing the problem.

Treat your computer gently, and it can perform without problems for years. Take care when moving it and treat it with consideration. Heat, extraneous magnetic and electrical fields, dirt, and rough treatment cause most of the problems after the warranty has expired. Take heart: if anything is inherently wrong with your new microcomputer, it will probably show up during the warranty period. The rest is up to you.

—Alan Radding

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In terms of trauma, a trip to a computer store ranks on a par with taking my auto to a repair shop. It might even be worse.

A few months ago, for example, I needed a modem for my Apple II. That shouldn't be tough to buy. Computer stores these days are pushing one popular model in particular, and I'm sure I could have bought it and made it work.

But that one didn't suit my needs. I wanted to use my computer to search bibliographic databases that charge as much as $175 an hour for connect time. The modem in question works at only 30 characters a second, one of the slowest speeds possible in the world of data communications. I already use an early 1970s dumb printing terminal that operates at the same speed. Sometimes I sit and watch words pour out of the telephone and onto the printer for 10 or 15 minutes at a stretch. That can run up a painful bill.

So I inquired whether there's a faster way. Let me tell you the story's conclusion right away. The answer is yes. It's possible to use an Apple II to communicate at 120 characters per second—four times faster than I'd been suffering with.

Making it work, though, may be akin to directing a troupe of acrobats. By the time I had assembled all the necessary components, I owned, besides the computer itself, an asynchronous interface card by another manufacturer, a modem by a third manufacturer, a connecting cable by a fourth, and communications software by a fifth.

Now all the parts were supposed to function together in harmony. They didn't.

The Classic Runaround

I went to the store where I bought everything. Nobody had ever encountered my problem before. None had ever seen my particular set of five components all joined together. Never mind that they sold them all to me and assured me that they would work.

I got handed off from one technical know-it-all to another. Did I set the communications card to the right speed? Yes. Did I read the instructions in the software manual? Yes. Had I perhaps broken the interface card's fragile connector? I brought the whole card back for a replacement: no improvement.

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Circle 141 on inquiry card.

They asked to see the manual that accompanies the modem, and then the one for the interface card. I gave them copies. There was one fellow who surely could figure it all out, but he was on vacation. Would I call him in a couple of weeks?

I called the modem company. An unsympathetic voice suggested my problem was in the interface card. I called the maker of that, who wondered if maybe the trouble was with the software. I called the software house. Did the modem work right? I called the modem people again. They ran a test with the device hooked up by phone to their computer. The modem was fine. Why weren't any messages getting through to my computer? That wasn't their responsibility.

I know not a whit more about electronics than auto mechanics, but I consider myself a resourceful person. So I sat down with the various technical brochures and started reading about DTE interfaces, parity, and communications protocols. Two-thirds of this was over my head, but I was surprised to find some understandable information. Was my RS-232C interface cable connected properly? Aha!

The modem, the card, and the software manuals all had something to say about the cable. I studied these sections. An RS-232C cable has 25 individual wires running through it, connecting at the male end to 25 pins and at the female end to 25 slots. But unlike electrical or telephone plugs, the individual wires don't necessarily go straight through. In other words, a wire might need to be attached to pin #3 on one end but to slot #2 on the other. In fact, that's just what my modem manual said to do, though the card manual said connect pin 2 to slot 2 and 3 to 3. Some of the wires needn't be connected at all, the modem manual advised.

A footnote in an appendix of the software manual was even weirder. It said: "Pins 4, 6, and 20 need to be connected. . ." Does connecting 4, 6, and 20 mean connecting them straight through—as opposed to not at all—or does it mean soldering them all together, as if I wanted to short-circuit the thing and set it afire? The computer store wasn't sure. I later found that it's the latter.

I brought my cable back to the shop and asked for one with 4, 6, and 20 connected, and 2 and 3 crossed. Even though I didn't know quite what it all meant, I figured their specialist would.

The Last Straw

A week later my custom-made cable was ready. It didn't work. I brought it in again with all my literature, asking the shop to follow the instructions and build a cable that worked. Another week, another cable. Still no go.

Finally I did what I should have done in the very beginning. I carried back the whole shebang—modem, cable, card, and software package—and said, "Please connect it to one of your Apples and show me how it works."

After another week or two, I received word: it worked fine. Please come take it home. The wizard who fixed it couldn't see why I was having so much trouble.

It was true. It worked the way it was supposed to. I was so glad I rushed right back to my office to hook it up. To this day, I don't know what I did wrong.

Finally, I was able to sit down and call my database. It wasn't a resounding success. Communications software, I discovered, was designed mainly for microcomputer-to-microcomputer uses, not for microcomputer-to-mainframe, as I wanted. Using such software to communicate with a database service is cumbersome, and thus doesn't save time as I had hoped. I'm back to my old-fashioned, slow printing terminal.

I heard recently that a software company soon will introduce a new program specifically for communication with mainframes. I can hardly wait to try it out.

—Doran Howitt

Circle 63 on inquiry card.

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AI for the Apple II?

Artificial intelligence it's not, but Savvy may be the next best thing

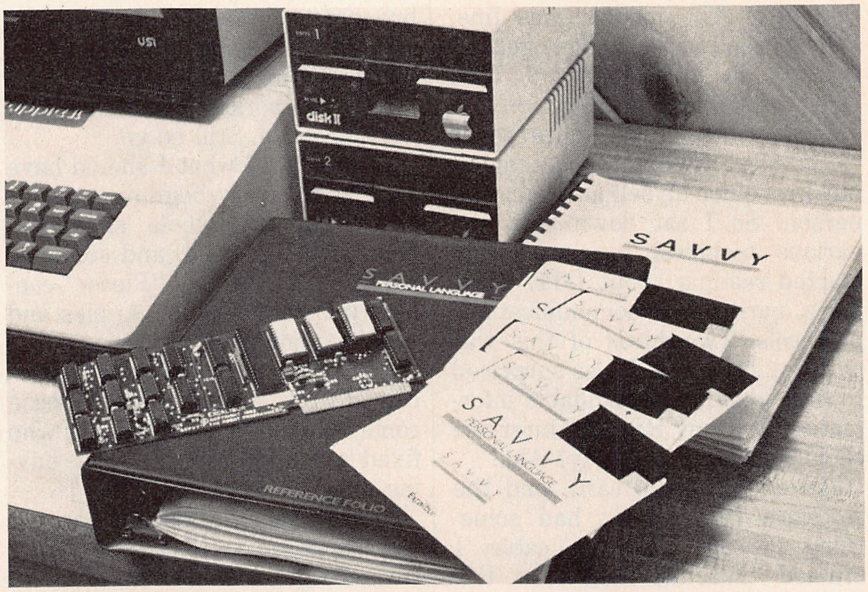
by Phil Lopiccola

If there's one thing that drives people nuts about working with computers, it's the inability of these so-called brainy machines to tolerate the slightest ambiguity. If we forget a comma or dollar sign in a programming statement, the program bombs. If we misspell or mistype a command during the program's execution, the computer balks without making the slightest effort to understand what we mean.

Naturally, when we heard about Savvy, an add-on for the Apple II that employs a unique system of pattern recognition to forgive typos, misspellings, and loosely stated instructions, we decided to investigate. What we found was a truly innovative approach to supplying a personal computer with a limited kind of reasoning or intuition.

The people at Excalibur Technologies Corporation, the research and development company that produces Savvy, avoid the term artificial intelligence, or AI, like the plague, chiefly to sidestep the scrutiny and wrath of the AI community. However, they do use the term "machine intuition" and claim that Savvy's pattern-recognition system is carefully modeled after the neural network of the human brain.

Lofty claims, but what is Savvy? Is its machine intuition just a parlor trick or a clever marketing phrase? What can Savvy do? And who can benefit from it? We'll answer these questions and take a close look at how Savvy works and how it differs from the traditional approach to artificial intelligence.



Savvy's plug-in card and software endow the Apple II with pattern recognition, an English-like programming language, a program generator for simple database management, and six applications programs.

What Is Savvy?

In a nutshell, Savvy is a combination of hardware and software containing a pattern-recognition system, a programming language, a program generator for database management, and a set of business applications programs.

The hardware is a plug-in card containing a Z80 microprocessor that works in parallel with the Apple's 6502 microprocessor. The card also houses the pattern-recognition system, memory-management software, and the factory-installed vocabulary.

The software includes four double-sided floppy disks which contain the system master, the demonstration disk with the database-management program generator, and the applications: a document writer/mailing list, payroll, accounts receivable, inventory control, and accounts payable/general ledger.

Phil Lopiccola is assistant managing editor of *Popular Computing.*

Photographs by Ed Crabtree

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This conglomeration of functions is intended for business and professional applications. Excalibur marketing specialists claim that the package is designed for people who have no knowledge of programming yet want a system they can mold in a short time to fit their operations and terminology, then modify easily as their needs change.

In general, we found nothing special about the database-management system or the applications programs. In fact, they leave much to be desired compared to other specialized programs on the market—even the designers admit "they're just plain vanilla." But they are, indeed, easy to implement and modify. For one thing, the documentation, prompts, and commands contain almost no computer jargon, so someone who has never operated a computer before could conceivably be running applications in a few days. In addition, Savvy supplies all the source code, or program listings, for its applications on each disk. That simplifies program modification especially because the Savvy language used for all the applications is close enough to English that by glancing at program steps, you can get a pretty good idea of what's going on in any particular part of a program.

The thing that sets Savvy apart, however, is its pattern-recognition system. In simple terms, it compares a digital pattern of the words you type with patterns of information it has in memory. If the patterns match perfectly, Savvy retrieves what you ask for or carries out your commands without question. However, if you misspell, mistype, or phrase something a little differently from one time to the next, Savvy tries to guess what you mean by acting on the word or phrase in memory that it thinks is most similar to yours.

At a Glance

Name: Savvy

Type
Business applications programs, programming language, program generator, pattern-recognition system

Manufacturer
Excalibur Technologies Corporation
800 Rio Grande Blvd. NW
21 Mercado Plaza
Albuquerque, NM 87104
(505) 242-3333

Price
$950

Format
Plug-in card and four 5¼-inch floppy disks

Computer
Apple II with 48K bytes of RAM (random-access memory) and two disk drives

Documentation
5-part, 360-page manual in vinyl looseleaf binder

Audience
Those interested in tailoring or creating business application programs or those interested in pattern-recognition technology

Artificial Intelligence?

Savvy does not endow the Apple II with artificial intelligence by any classical definition of the term. For instance, consider the imitation game test developed by Alan Turing from his work in the late 1940s and early 1950s and still considered a valid test of artificial, or machine, intelligence. The Turing test pits an interrogator against another human and a computer. Able to communicate with each via keyboard and printer only, the interrogator tries to determine which is which. If he can, the computer is not considered intelligent. It's unlikely that the Savvy system could be set up to pass such a test.

Nevertheless, Jim Dowe, inventor of Savvy and one of the founders of Excalibur, describes Savvy as "a digital implementation of the human brain's neural network." He says his work was inspired by the book *The Origin of Consciousness in the Breakdown of the Bicameral Mind* (Houghton Mifflin, 1977) by Julian Jaynes, a professor at Yale. "I'm not saying that all his theories are right—I just don't know. But what he said made a powerful difference in our work." The other key influence, says Dowe, was the work done in pattern recognition by Dr. Iben Browning and Dr. Woody Bledsoe who at that time were at Sandia Corporation. Part of Browning's work, which dates back to the late 1950s, appears in a book called *Robots on Your Door Step* (Robotics Press, 1978) by Browning and Nels Winkless.

Winkless, a consultant and one of the founders of Excalibur, explains how Excalibur used these theories. "We believe that in mammalian brains there is an analytical system as well as an intuitive system at work." For instance, says Winkless, throughout our evolution the analytical system alone wouldn't have been enough to keep man from being eaten by predators. "If a tiger jumps out at you with its claws sticking out, its teeth slobbering, and its eyes stopped down to pinpoints, you don't hang around analyzing all the grisly details. Your intuitive response, built in somewhere along the line, tells you to run like hell.

"What we have done, then, is combine an intuitive processor that makes assumptions based on incomplete information with an analytical processor that chews the bits like any other computer. The combination is something people could call artificial intelligence," he says. "In fact, I can go through the system and find what I perceive to be synapses, and I can see where the neural firing occurs, and so on.

"We think the Japanese promotion of their fifth-generation computers with artificial intelligence is a scam. They're talking about doing in 10 years what we and some others are starting to do here already," he says. "Yet I can get you affidavits written in blood from many respectable computerists, swearing we can't possibly do what we're doing already and that we are lying about how we do it."

Pattern Recognition

The Savvy approach is at right angles to traditional AI work, according to Winkless. Instead of defining all the characteristics of something for the computer and then letting it sort out what it is looking at, the Savvy designers let the computer define characteristics on its own.

"When we wanted Savvy to distinguish between a U and an O, for example," says Winkless, "we did not tell it that a U is like an O with the top missing or describe other differences that we might notice. We instead designed Savvy to compare a digital representation, or pattern, of both the U and the O with its own arbitrary patterns to come up with a definition of each."

In the same way, Savvy defines the characteristics of complete words and phrases. Imagine assigning a numerical value to each letter so that A is 1, B is 2, C is 3, and so on. If you take a phrase like "List the employees" and plot the numerical value of each letter on a graph, you get a pattern that looks like the profile of a mountain range. Savvy compares that mountain-range pattern to its own set of random patterns to define the phrase and store it in memory. Later, if you mistype in something similar like "List all employs," Savvy finds enough similarities that it will understand, or should we say, savvy, what you mean.

You can also tell Savvy to associate one phrase, or pattern, with another. That way you could teach it that "List the employees" means the same thing as "Who works here?" Thus you could call up the program in any number of ways. In fact, you could conceivably associate additional phrases like "Name the staff members," "Haga una lista des empleados," or "Wer arbeitet hier." Savvy would then understand inputs like "Haga una lista the people who work here" or other mixtures of phrases and languages. People have reportedly implemented Savvy in French, Greek, Spanish, German, and other languages.

One warning: Savvy's pattern recognition can lead to trouble especially when you use terms that look nearly identical but have entirely different meanings. For example, if you ask it "Who has been hired lately?" it might think you wanted to know "Who has been fired lately?" Chances are, in this particular case, that if Savvy knows the word hire, it also knows fire. But in many instances you might not be as fortunate.

"That question keeps coming up," says Winkless. "But we always say that the machine is like a kid. It depends on its experience,

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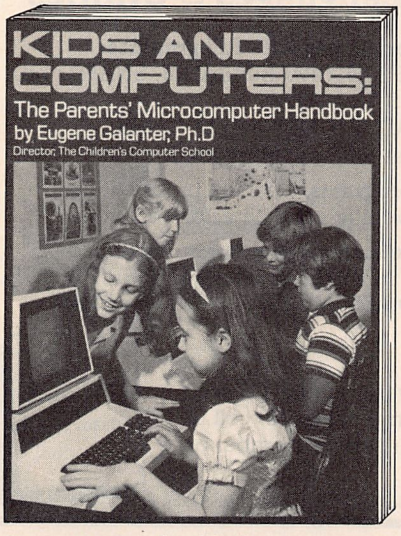
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on what you teach it. And because you tend to teach the machine what you think is important, you don't usually run into trouble unless you do something odd. Even then you can fix it simply by associating the old phrase with a new one."

An interesting aspect of the system appears when you want to teach Savvy new words or names of files in memory or give it new tasks. You can get Savvy to accept precise inputs by typing in "Literal." Savvy responds with "I'll make no assumptions." When you're finished, you can get Savvy to again accept your misspellings and irregular wordings by typing in "Free." Savvy then responds with "I'll use my best judgment." The Free mode comes up each time you turn on the system.

An important feature of Savvy is that it supposedly continues to improve in its discrimination as you teach it more and more associations. "It doesn't become saturated," says Winkless. "The traditional curse to most pattern-recognition systems is that after a while patterns begin to look alike. After about a dozen slightly different representations of the same basic pattern, the image blurs. And the system finds more similarities than differences. The virtue of Savvy is that it doesn't saturate. Its discrimination improves. We have not yet found its saturation point."

The pattern-recognition algorithm is supposedly so simple that the people at Excalibur guard the technical details closely and describe how it works only with analogies of tigers and mountain ranges. "The whole thing resides in about 4K bytes of memory," says Winkless. "In fact, there are very few variables in what we are doing here, but they are a slightly different set than people normally work with. It's not terribly complex, which is why we are trying to keep it secret and maintain a year or two lead time in the field."

The Programming Language

The Savvy language was designed so that nonprogrammers could use it. However, you still need to have the same understanding of a task that you need with any other programming language. For instance, you must set up program loops, handle if/then statements, and learn the computer's vocabulary. "Savvy in no way can read your mind about the end result you want to reach," says Bill Slade, operating-system manager at Excalibur and key architect and programmer of Savvy. "Still, it offers distinct advantages over traditional languages such as BASIC, FORTRAN, and Pascal."

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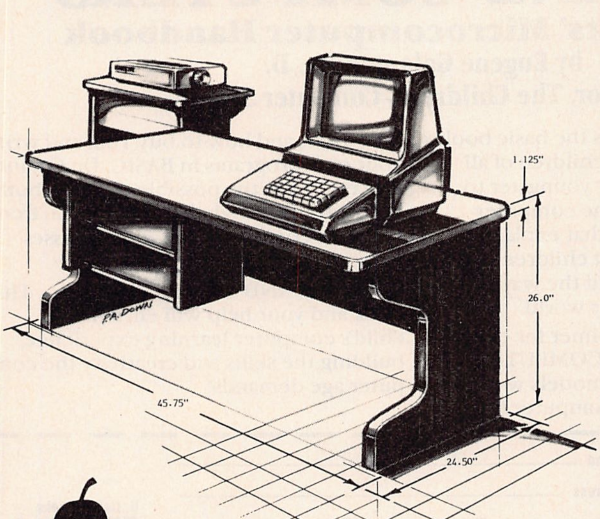

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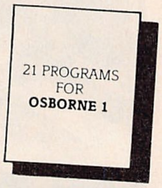

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```
0 -- Task ADD TO THE DIRECTORY FOLDER

 1 Does START a loop
 2    Do   ENTER A DIRECTORY PAGE
 3    Do   CREATE A PAGE ID FOR DIRECTORY
 4    Do   SAVE new page in DIRECTORY
 5   and   CARRIAGE return
 6   and   DISPLAY the "SHOULD WE ADD ANOTHER ONE?"
 7   and   INPUT into ANSWER
 8   and   IF the ANSWER IS NOT YES then
 9    Do      LEAVE this loop
10   and      END of test
11   and   REPEAT this loop
12   and END  (TASK is 6% full.)
```

This simple program shows the friendliness of Savvy's programming language in which statements resemble English phrases. You type in the commands (in all caps), and Savvy prompts you or completes the programming statement. Notice, however, that while you need not use arcane symbols and syntax, you still need the same basic understanding of the task that you need with any other language to write a program.

your programming statements. A language like BASIC requires that you type an intricate series of symbols, parentheses, abbreviations, commas, and semicolons in exactly the right order and with no typos. With Savvy, on the other hand, you write the statements in English with virtually no need for special symbols.

For example, in developing a personal telephone directory, you'd want to be able to add new pages to the directory. To do so you would simply type "Define," Savvy would prompt you by adding "a task called," and you'd complete the statement by adding "Add to the directory." Your final program would look something like the example shown at left.

As you can see, the program reads somewhat like English phrases and displays your responses in uppercase words and Savvy's prompts in lowercase. Although Savvy's "Do" and "and" prompts at the beginning of each line don't always make sense, the rest of the prompt can be very helpful not only while you're writing new programs but also when you're modifying old ones. This system of prompts relieves you from writing a lot of extra documentation.

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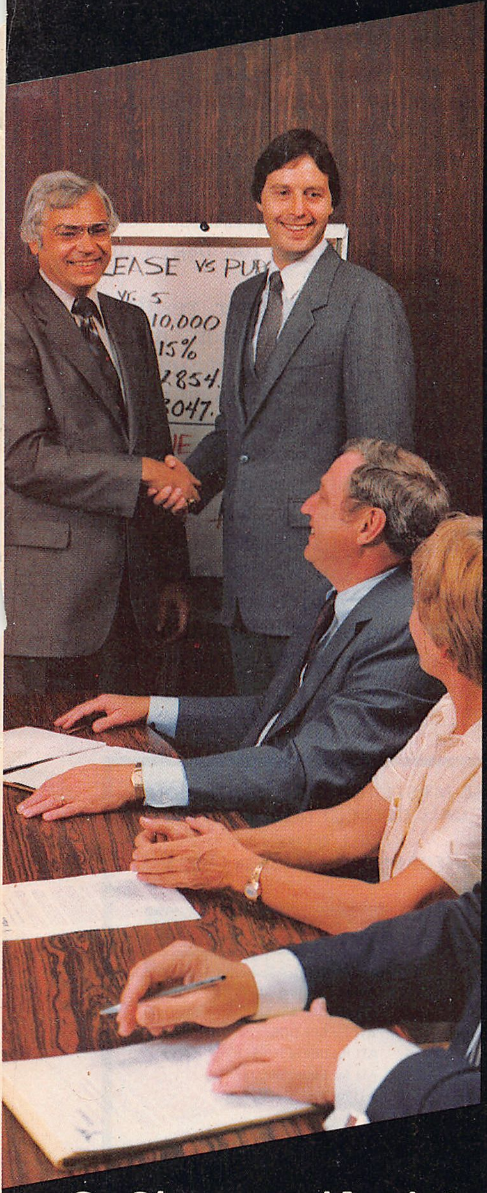
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in general, is the instant feedback you receive after typing invalid entries. For instance, suppose Savvy displays "What would you like me to do now?" as it does from its "ready" position. Instead of giving Savvy a command, you type in the name of a file or a term like "Archive." Because Savvy doesn't know what to do, it displays "I was hoping for a task, a function, a primary, or a command. But Archive is an item. Please try again." That response gives you feedback about what you did wrong and what you should do next.

"Also, Savvy's calculations are accurate to 26 decimal digits," says Slade. "On other 8-bit computers you typically run into round-off errors when dealing with very large or very small numbers. If you try to do any kind of simulation using the national debt, for instance, you might be off by several million dollars. But with Savvy you can do scientific calculations with far greater accuracy than with any other programming language for personal computers."

The 146-page programming section of Savvy's manual is virtually free of technical jargon and takes the beginner step by step through elementary examples and through Savvy's factory-installed 100-plus-word vocabulary. In fact, in just a few days, anyone could learn to write simple programs with Savvy. The programming section could even be looked upon as a tutorial on the basics of programming.

But alas, when all is said and done, Savvy does require substantial effort on the part of nonprogrammers when anything but the simplest applications are required. To write sophisticated programs or to modify existing programs demands a more thorough understanding of programming concepts than the documentation supplies.

The Robot Programmer

You can use the robot programmer as a program generator only to create simple databases like phone directories, address books, or lists of contacts. It cannot generate other types of applications. It does use the pattern-recognition system, as do all aspects of Savvy, on tasks, commands, and names you specify as identifiers for pages in the database.

The robot programmer resides on Savvy's demonstration disk. Once you call the robot up, it queries you about the information you want it to contain and about how you want it displayed. For instance, to generate an address book, you simply name the database "Address book" and give the coordinates of where you want the names, addresses, phone numbers, and other information to appear on an imaginary grid on the screen.

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To test the robot programmer we created an address book with 120 names. After answering the queries, we sat mesmerized in front of the screen as the robot displayed all the programs for using an address book as it wrote them. In about 10 minutes, the robot wrote 9 programs in the Savvy language including Create page identification for address book, Add to address book, Show page from address book, Change page in address book, Look in address book, and so on. Granted, the robot put on this dazzling display purely for the sake of showmanship. Nevertheless, we found it fascinating to watch Savvy ask itself questions about format, field lengths, and so forth and then answer itself on screen.

After we loaded the book with names and addresses and indexed it by last name first and first name last, we typed in a few names to make sure Savvy was retrieving pages correctly. When we typed in Twilley, we got Cuspid J. Twilley's name and address, as expected. When we typed in Whipsnay, we got Larson E. Whipsnay's name and address. When we typed in Friedman, we got Scott Gagnon's name and address.

Wait a minute! What did Gagnon have to do with Friedman? Did Savvy know something about these two that we didn't? Was Savvy's machine intelligence tied in to Central Intelligence? Sure enough, at birth the two had been accidentally switched in their cribs at the hospital and, er, just kidding.

Actually, Excalibur claimed that either a bug was responsible for the mix-up or that we had done something funny at the end of our entry for Friedman because Gagnon came right after Friedman in the sequential file. Whatever the cause, we entered the data again and this time it worked correctly. We then had some fun misspelling names and getting them to come up right, so maybe there's hope after all for people with commonly misspelled names.

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The documentation describes how you can create other elementary databases with the robot programmer, including a business-card list, a thing-to-do list, a household-inventory list, and so forth. It's a system that's easy to program and use and fun to experiment with. But the robot programmer is intended for simple file-management types of applications. If you want more advanced data manipulation, sorting and retrieval, you might investigate the more sophisticated database management systems like Condor or dBASE II.

Of course, the people at Excalibur claim that it's possible to use the Savvy programming language to create your own robot programmer. Indeed, experienced programmers or professional software developers might want to create new robots to build other applications. But that's hardly a job for beginners.

Applications Programs

This set of conventional small-business applications programs offers nothing very exciting. The programs are fully menu-driven and use the pattern-recognition system so that you can request files and names imprecisely and have them appear. Obviously, the pattern recognition works only with text and not with numbers.

Probably the best feature of the programs is that Savvy includes the source code for all the programs right on the disks. This means that after making copies of the original programs for safekeeping, you can rewrite applications to your heart's content.

"We call it generic software," says Joe Clark of Excalibur's marketing group. "We provide all the source code so people can modify any application. If they don't like the way the printer report looks, for instance, they can get a complete listing of the program by using the Detail command and then make as many changes as they want." The software includes six applications:

Document writer/mailing list is a text-editor program that lets you create a letter, edit it, and mail it to any number of people on your list. The program performs tasks such as alphabetizing the mailing list and inserting appropriate salutations in the letters. It is not intended to be a word processor. Excalibur hopes to introduce one by the middle of this year. Documentation for the Document writer/mailing list is sketchy, just as it is for all applications. It provides general instructions and shows you how to change information and how to print or display the mailing list. Excalibur plans to introduce improved documentation featuring more examples for all applications sometime this year.

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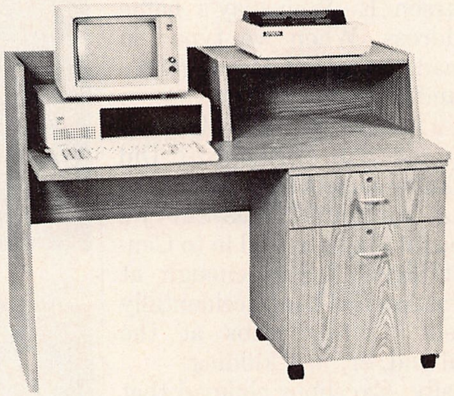

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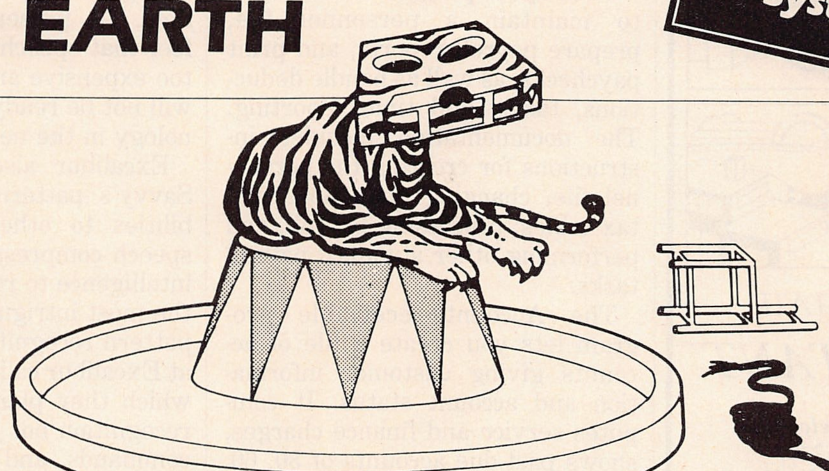

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The Payroll program enables you to maintain a personnel file, prepare payroll reports, and print paychecks, as well as handle deductions, taxes, and time reporting. The documentation includes instructions for creating the personnel file, changing deductions and tax tables, processing payroll, and performing other standard payroll tasks.

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Accounts payable keeps track of the people you owe, how much you owe, and prints out your checks for payment. General ledger keeps track of all your accounts, debits, and credits and prepares income statements and trial balances. Coming soon, Excalibur reports, is Planner, an electronic-spreadsheet system.

Next for Savvy

The current version of Savvy runs only on the Apple II—not on the Apple IIe. Foremost in Excalibur's plans, besides adding new packages and improving the documentation, is developing versions of Savvy for the Apple IIe, the Apple III, the IBM Personal Computer, and all top-selling personal computers. Also, because speech pattern recognition is already built into the system, the people at Excalibur say they will continue to investigate opportunities in that field. At present, however, they feel that speech input devices are too expensive and that the market will not be ready for the new technology in the near future.

Excalibur also hopes to apply Savvy's pattern-recognition capabilities to other areas including speech compression and supplying intelligence to robots. But perhaps the most intriguing use of Savvy's pattern recognition is what people at Excalibur call the memory pit, in which they plan to apply pattern recognition not just to tasks, files, commands, and names but to the data as well. They foresee no technical inhibition to putting something like the *Encyclopaedia Britannica* in 150 megabytes of memory and using the pattern-recognition system to ask for information on any particular subject. The system would take what you describe and bring back what it thinks is most similar.

Is Savvy for You?

The future looks bright for Savvy. Its possibilities are many and even the developers aren't sure where the applications for pattern recognition will lead them. But how useful is this first application? Is $950 too steep a price to pay for simple business applications, a new programming language, and a system that forgives your sloppy typing and poor memory? It would seem so, considering how many sophisticated and more specific business packages you could get for the same price. But if you want simple applications that you can fine tune with perhaps the most friendly English-like programming language to date, this package might be just the ticket. Also, if you like to keep close watch on what's happening in the field of machine intelligence, Savvy's pattern-recognition system has already established an impressive new track. Its potential for spectacular breakthroughs in the future is even more exciting. □

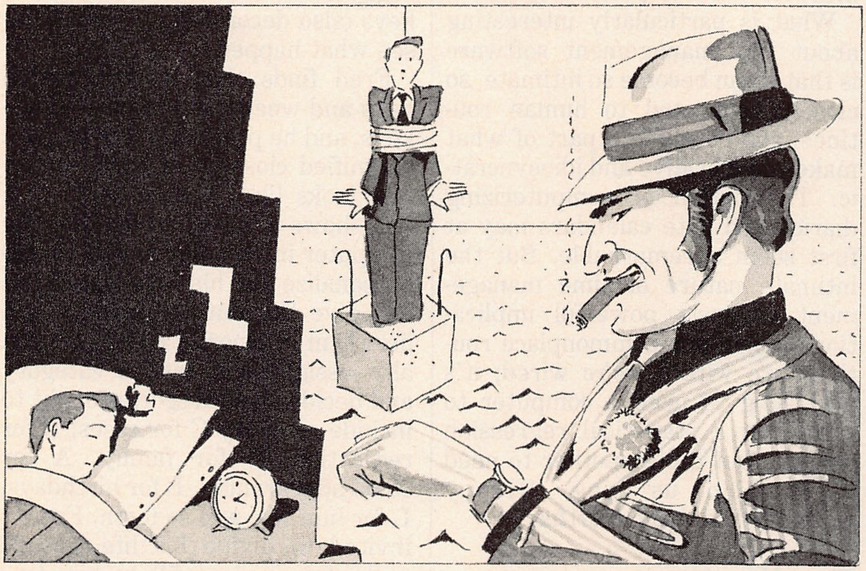
HOME/BUSINESS

Time-Management Software

You'll never again forget Aunt Martha's birthday

by Peter Owens

Can a computer make a person smarter? After munching on the question a bit, most people would probably say no. A computer is no more clever, after all, than a donkey. Like a donkey it can make a person's life easier, but it can't make that person any smarter. Just ask any farmer. Some people might even argue that because it is a machine, a computer is probably dumber than a donkey. So how can a machine that is dumber than a donkey make anyone smarter?

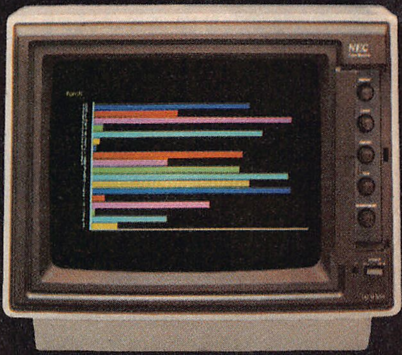


Most computer operations are extensions of human work. The machines can execute ponderous and time-consuming computations instantly or assemble and manipulate huge masses of data at the speed of light. This frees people to do other tasks, other work. But certain kinds of computer programs—some of the time-management software—seem to crawl inside the brain itself. The computer takes over certain brain functions, enabling the brain to make cognitive choices that otherwise would not be possible. By completely taking over those functions, the computer frees the brain to carry out other higher-level mental operations—and the person becomes smarter.

But, you're scoffing, isn't it a bit preposterous to claim that computerizing such a mundane task as time management can be mind-expanding? And with all the miraculous labors computers can perform, why in heavens ask them to take over the scheduling of appointments or the tedious duties of reminding, say, attorney Fred Smith about Thursday's tennis with Judge Davis, Aunt Martha's birthday on Saturday, or Rocky Bambino's pretrial hearing Tuesday morning? Such scratch-pad tasks seem so inelegant and pedes-

---

Dr. Peter Owens is a professor of English at Southeastern Massachusetts University in North Dartmouth, Massachusetts.



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trian, so uncomputer-like, and yet they're the essence, heart, and soul of time management.

It is precisely by teaching a computer to take over such untidy functions that harried lawyers, absent-minded professors, fuzzy-minded accountants, hassled physicians, babbling business people, brain-warped psychologists, and wild-eyed scientists can indeed think more clearly and screen out many of the distractions and half-forgotten details that overload their brains and force them to make foolish, seemingly incompetent errors. With time-management software a machine processes once what people must otherwise process over and over again, taxing both their short- and long-term memory often when they need it most for other important tasks.

What is particularly interesting about time-management software is that it can become so intimate, so closely connected to human routines, and so much a part of what makes people alive and idiosyncratic. The notion of computerizing diaries and date calendars may at first seem unremarkable. But the intimate nature of time management suggests powerful implications: when our commonplace routines are wired, *we're* wired; it's one thing to need a computer to carry out a statistical regression analysis but quite another to need it to help us sing "Happy Birthday" to Aunt Martha.

Time Manager

To get a view of how computerized time management can sneak into the corners of one's life and clean out the cobwebs of faulty memory, I examined the Time Manager program (for the TRS-80 Models I and III) which, according to the manuals, "helps you organize and plan your activities while maintaining accurate and complete records for future reference." For the purposes of illustration, let us assume that the user in this case is attorney Fred Smith, a criminal lawyer, family man, and tennis nut. He loves the law but also loves his sailboat and his two children Carrie, 7, and Richie, 5. Like many professionals, Fred is nearly always late, feels chronically behind and never really on top of things.

His psychiatrist tells him these are normal stresses of professional life and suggests that Fred buy himself a computer and the Time Manager program to help him sort things out, to help him think and remember better. Fred does just that, discovering quickly that at the heart of this program is a calendar displayed on his monitor with hardly any more sophistication than a few rows of numbers etched on a caveman's wall. But some arrows on his calendar point to the day's date, and the users manual suggests he push the directional keys (also decorated by arrows) to see what happens.

Fred finds that he can switch days and weeks with a push of the keys, and he presses Enter to get a magnified close-up of what tomorrow looks like. This close-up of a day shows a list of duties that the computer invites him to add to and personalize for his own use. Fred can give the duties numbers and list them in priority order. He can also assign each task a category and decides his categories ought to include category C for cases, R for recreation, F for family, A for court appearances, B for birthdays, L for lunches, and so forth. Fred is invited to divide his life into 26 such slots and to fill in his days with the duties that he thinks are worth remembering.

Rocky Bambino

Fred reaches for his daily flip-calendar with its chaos of entries, scribbled in his impossible script. He knows that on February 3 he must file an answer on behalf of Rocky Bambino, who has been charged with extortion by the grand jury. He presses several keys listed in a command chart in the manual and in a moment has February on the screen, then Feb-

Illustrations by Andrea Baruffi

ruary 3. He magnifies the day and is asked what priority his entry will be.

He has five choices (*, 1, 2, 3, and note), and because he knows Bambino will outfit him with cement boots and dump him in one of the local ponds if he misses that court appearance, Fred enters the top priority by pressing the * key. The computer then asks if it will be a permanent entry such as an annual event like a birthday.

He shrugs a moment. The only way Bambino's court appearance can turn into something permanent is if Fred misses it. In that case Fred's execution will make every February 3 something special. He tells himself that the computer will remember Bambino and enters nonpermanent, category A, and then types in the text of his task: "Bambino answer, superior court, 9 a.m., note pad." He has a total of 49 characters and spaces for his entry, so he just makes it without calling on a line-expansion command. Instead, he uses the "note pad" function to remind himself what to do about his client. He presses the note-pad command and enters the message: "Bambino is innocent: just ask him: he is always innocent: remember that. Enter not guilty plea." Fred is big on notes to himself and will make heavy use of the note-pad display.

Bambino is a busy man, however, and Fred has seven other appointments, appearances, and related duties that involve Bambino, including a tennis game on February 10 with Bambino himself and a luncheon on January 27 with Judge Davis. These are all the highest priority. He finds the days and makes the entries. Fred is haunted by Bambino and lives in mortal terror that someday he will forget something. Just to protect himself, he decides he will use a keyword scanner. He enters "Bambino" as his keyword and then uses the directional keys to move ahead or back in time until any Bambino-related activity stored in his calendar is displayed. To free himself of Bambino's nagging presence, Fred learns to use the scanner every morning when he first comes into the office to see what he needs to do for Bambino.

Just Another Day

Sometimes Fred is so hassled by all his work that he just wants to see what fun he might expect from a day. He displays the activities under category R and sees he has tennis at 1 p.m. with the assistant D.A. and will go sailing with his wife at 5:30 p.m. He sees a note-pad indication and pushes the note-pad command. Suddenly the console announces: "Low tide will be at 6:45 p.m. Bring clam fork, clam license, six pack."

Gratified that the day will not be a total loss, Fred presses the display for the day's complete activities. In order of priority he sees: "Sailing with wife, flowers for Judge Adams, traffic cases from 9 a.m., divorce hearing for M. Green, luncheon with Judge Adams, pay fuel, order tickets to Philly, get present for Martha's b'day, call Bob about tennis."

At a Glance

Name Time Manager

Type
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Price
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Format
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Computer
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Audience
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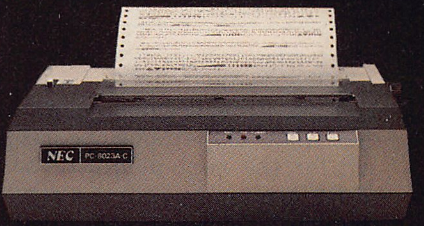

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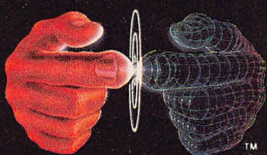

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Then Fred decides he wants to see what tennis games he has lined up for the next month or so. He calls up a tennis scan and sees that he has 17 games scheduled. He smiles and pats his computer fondly on the top of its console. The computer remembers all. He listens to see if his secretary has arrived yet. She hasn't, so Fred pushes the keyword command for "Adams" and scans for his appointments with her over the next month. He hears his secretary come in the door, and he frantically presses the Clear button. Clearly he needs a code for Judge Adams so that his secretary does not become suspicious.

A Personal Accountant

The Time Manager also contains an accounting system that offers listings and computations for accounts receivable, accounts payable, hours worked, expenses, salary income, commissions, accounts paid, purchases, charges, and so forth. The user can substitute any equivalent listing and call upon the accounting functions at any time by pressing the J category listing for job accounting.

The program lets you enter various sums of money in the accounting categories each day and can calculate running totals for particular time spans. For example, Fred charges Bambino $300 an hour, much more than his other clients. He keeps Bambino snugly nestled in account number one. In only a few seconds, Fred can figure out how much money he made from Bambino over the past six months, and this total makes him forget how hazardous having Bambino for a client really is.

Fred is able to keep track of all his billing, all his expenditures, all of his and his secretary's hours, all his luncheon and other deductible expenses, and so forth. He enters this information on the days in question and lets the computer take care of weekly, monthly, and annual totals. Each disk ordinarily stores up to a year's data and can be kept as a permanent record. The accounting system will compute sums not exceeding plus or minus $499,999.99, which for Fred's purposes is sufficient.

Even with its complexity and wide variety of functions, the Time Manager is easy to learn and is clearly explained by the users manual, which not only shows the learner what to do but explains why as well. Novices can quickly master the calendar and diary portions of the program. Ultimately expert users can attach a printer and compile financial reports.

For Insomniacs and Others

In many ways, the Time Manager struck me as being

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similar to insomnia, the mind's most tiresome processing treadmill, wherein the mind branches out on various pathways of associated worries and obligations, struggling always to set priorities and find an order for things.

Insomniacs, of course, can never be sure an important chunk of memory is entered in long-term storage, so they'll play the category or the keyword over and over, setting up fierce rehearsal loops that seem never to end. Once exhausted by this process, the insomniac's mind will drift to lesser priorities or related tasks. As the mind organizes and slots the data, slumber sets in, but suddenly a forgotten item jolts the poor victim into a four-star alert, and a new search for order begins once more.

The Time Manager seems to do what the insomniac cannot. The program fixes time, category, memory, and urgency; all you have to do is press a button in the morning. This is not to say the program could cure insomnia, but it does offer to put your affairs in order, clear the mind, and reduce cognitive strain, thus letting you concentrate on the substance of issues and not the clutter around them.

Finding the motivation to buy, learn, and then use the Time Manager or an equivalent time-management program is another matter. To tackle the program requires time, and it is the shortage of time in the first place that plagues the harried professional. Thus the program requires a commitment of time to save time.

The TRS-80 Time Manager has a certain elegance; it is clear, clean, and nicely presented. Yet I can't help but think it is primitive compared to the future of such intimate, life-style, and organizational software. To be truly effective, such programs and their computers will have to be highly portable—small and light enough for a purse, pocket, or briefcase. When this happens, time management will surely become as pervasive as the calendar itself. □

GAMES

Deadline for Binary Bogarts

You have 12 hours to crack this challenging interactive whodunit

by Lee Gomes

SFPD inspector Callahan knelt near the stiff. "All right, Gomes—start talkin'," he growled at me. "This is 1983, pal, not some '40s Bogart movie. Do you mind explaining why this corpse is packing a .38 registered in your name?"

It had been nine hours since I bummed my last soggy cigarette, and there were saddlebags under my eyes that only Robert Mitchum's mother could love.

"I'm gonna give you just one more chance, Gomes," the inspector thundered. "If you can't crack Infocom's new computerized adventure game, Deadline, in just 12 hours, I'll see to it that you never work as a private eye again. Not here, not even in Manitoba."

One of the plainclothes goons shoved a big manila envelope in my face. "This is all you'll need," said Callahan. "It's got your floppy, plus a photo of the death scene, interrogation transcripts, coroner's

---

Lee Gomes has written for *Esquire* and the *Honolulu Star-Bulletin.*

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report—everything." The grizzled detective glanced at his watch. "Okay, hot shot," he sneered, "you've got till 4:08 this afternoon to crack the case or you're through."

Callahan and his boys still had plenty of paperwork to do, so I trudged wearily back to my "office"—a one-room apartment in the Mission district. Luckily for me, it was Saturday. That meant that Leighton Trumbull would be free all day. Well, not exactly free. Monday through Friday, Leighton attended the junior high school down the block. On weekends, the little runt made a fortune writing custom software. It was still too early to phone the preteen entrepreneur, so I poured myself three fingers of Johnny Walker Black and started reading the Deadline dossier.

The victim's name was Matthew Robner, and this guy was no pauper. Big house in Connecticut, servants, the whole nine yards. He died at home, and the lab reports indicated suicide. But the interrogation transcripts showed that about half of Robner's buddies and employees wanted him dead. The suicide angle just didn't wash.

This was Callahan's challenge: find out who killed the Connecticut high-roller but do all the sleuthing at home. No phone calls. No slurping Scotch with real-life suspects. I had to use a personal computer to solve the murder!

It was time to call Leighton all right. I kept the apology short: "Hey, I'm sorry to wake you up at six o'clock on a Saturday morning, kiddo, but I need your computer expertise real bad. And kid—I'll toss in an extra C-note if you get your Apple II over here in the next half hour." The promise of a bonus was enough to get the 12-year-old computer wizard cracking.

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Leighton was fondling the floppy and telling me, "It's not a shoot-'em-up computer game, Mr. Gomes. It's an adventure game."

"A what?" I asked.

"You know, an adventure game," Leighton echoed. "You're placed in a situation—a cave, a distant planet, maybe a haunted house—and whatever happens to you is predicated on your choices. These games don't have a fixed number of enemies you must destroy, like the simpler computer games do. Victories, disasters, blind alleys—they're all determined by the way the program branches. Adventure games are called 'interactive', Mr. Gomes, because the player interacts with the software. In a sense, the player is master of his own destiny."

Destiny, indeed. Maybe Mickey Spillane was destined to get the blondes and the beer commercials while, in a separate roll of the dice, I was destined to study programming in some crummy night school. "Come on, Leighton. Show me how to get started."

With Leighton's assistance, I found myself at the entrance to the Robner estate. By displaying a few sentences on the screen, the machine would tell me where I was and who else was there. It would let on, for example, "You are in the master bedroom. Mrs. Dunbar is here."

Getting around was easy. I just typed N if I wanted to go north, Enter if I wanted to go through a doorway, and so on. I could also instruct the computer to do little jobs for me, and it would answer sarcastically—like a digital Dr. Watson. For instance, if I asked it to pick up a desk, it would tell me, "The desk is too heavy."

Using the computer I could converse—if that's the right word—with all the members of the household. Because the case was officially listed as a suicide, when I told the computer to "ask Mrs. Robner about the murder," I got a reply from the widow accusing me of "melodramatic insinuations."

I had a lot of house to explore—two floors, a score of rooms, dozens of objects (not to mention the rambling lawns and the lake). The task at hand, then, was to wander around the estate, poking through rooms, examining evidence, talking to suspects and others in the know. At times I wanted a stiff drink, and I don't mind telling you that the deceased's liquor cabinet was pretty disappointing.

Toward game's end, I became obsessed with the mundane activities of George Robner, the deceased's eldest son. When George went into the kitchen and fixed himself lunch, I asked the computer what he was eating.

"A red herring," it said. I realized I had been wasting my time.

At a Glance

Name: Deadline

Type
Home entertainment

Manufacturer
Infocom Inc.
55 Wheeler St.
Cambridge, MA 02138
(617) 492-1031

Price
$49.95; $59.95 for CP/M and NEC Advanced Personal Computer versions

Format
5¼- and 8-inch disks

Computer
Apple II, Atari 400/800, IBM Personal Computer, NEC PC-8000 and Advanced Personal Computer, TRS-80 Models I and III, Commodore 64, Osborne 1, and any CP/M-based system with 8-inch disk drive; requires 32K bytes of read-only memory (ROM) and one disk drive

Documentation
Manila folder full of evidence

Audience
Adventure-game enthusiasts

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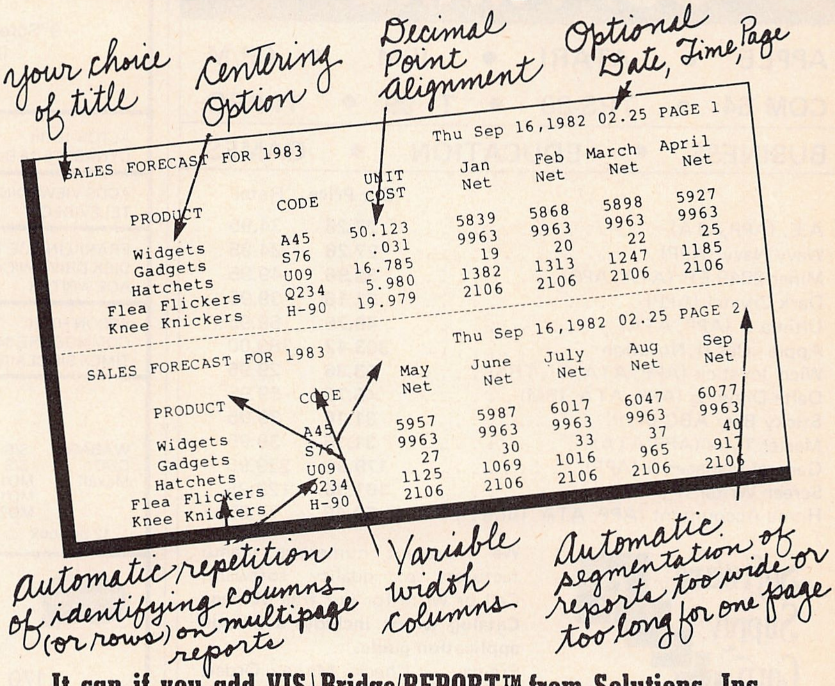
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 PRODUCT        CODE      COST
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 Widgets        A45     50.123    9963     9963    9963    9963
 Gadgets        S76       .031      19       20      22      25
 Hatchets       U09     16.785    1382     1313    1247    1185
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                                      Thu Sep 16,1982 02.25 PAGE 2
SALES FORECAST FOR 1983
                            May    June    July     Aug     Sep
                            Net     Net     Net     Net     Net
 PRODUCT        CODE
                                                   6047    6077
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 Gadgets        S76        9963    9963    9963      37      40
 Hatchets       U09          27      30      33     965     917
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Leighton, who had been watching all this, was quite impressed. "Hey, that's neat," he cooed. "The game allows for some pretty complex syntax—like when you typed, 'Take the bottle out of the cabinet.' "

"You mean when the program let me have only one drink?" I asked.

"Yeah. You typed a complete sentence, and the game understood it. That's nice programming."

Leighton was right—the game had many original touches. For instance, when I asked the computer to look under the bed, it replied, "I suppose you were expecting to find the bogeyman. But he's not here."

Throughout the game a clock at the top of the screen displayed the time I had left. Even though each move took just a few minutes, my remaining time had dwindled to four hours. Callahan was probably thinking up to 60 different ways to shred my private-eye license. Yet even as the pressure mounted, I marveled at the computer's efficiency—how it kept track of where I'd been and what I knew. Say I was in the guest bedroom and I found a letter Mrs. Dunbar wrote confessing to the murder as part of a scheme to get Robner's money. Armed with that, plus the incriminating fingerprints I found in the library alongside Robner's body, I could order the dizzy dame arrested.

Then the game would be over, and I'd just have to wait for a report on the legal outcome. In this case, the computer would tell me that the evidence against Mrs. Dunbar was pretty meager; therefore, she'd easily get acquitted with the help of a high-priced lawyer. In short, I'd neither win nor lose.

A note in the Deadline dossier explains that the game has about a zillion no-win outcomes, about a half dozen "you're getting very, very warm" conclusions, but only one optimum solution. When the sleuth gets killed, that's a tip-off that the 12-hour ordeal has ended in a "very warm" solution. Obviously, the optimum solution is the one where the detective lives to see the murderer severely punished.

Anyway, I bet you're dying to know what happened when Callahan and his creeps showed up. I swallowed hard and typed in the name of the person I wanted arrested. "Bingo, you quiche-eaters," I exclaimed. Yes, I had latched onto the optimum solution. Justice had been done, and I was still alive to boast about it.

"Leighton, I'm bushed," I confessed with a Scotch-scented yawn. "It's time to grab a few winks. Oh, and if Robert Mitchum calls while I'm asleep, tell him to find his own optimum solution." □

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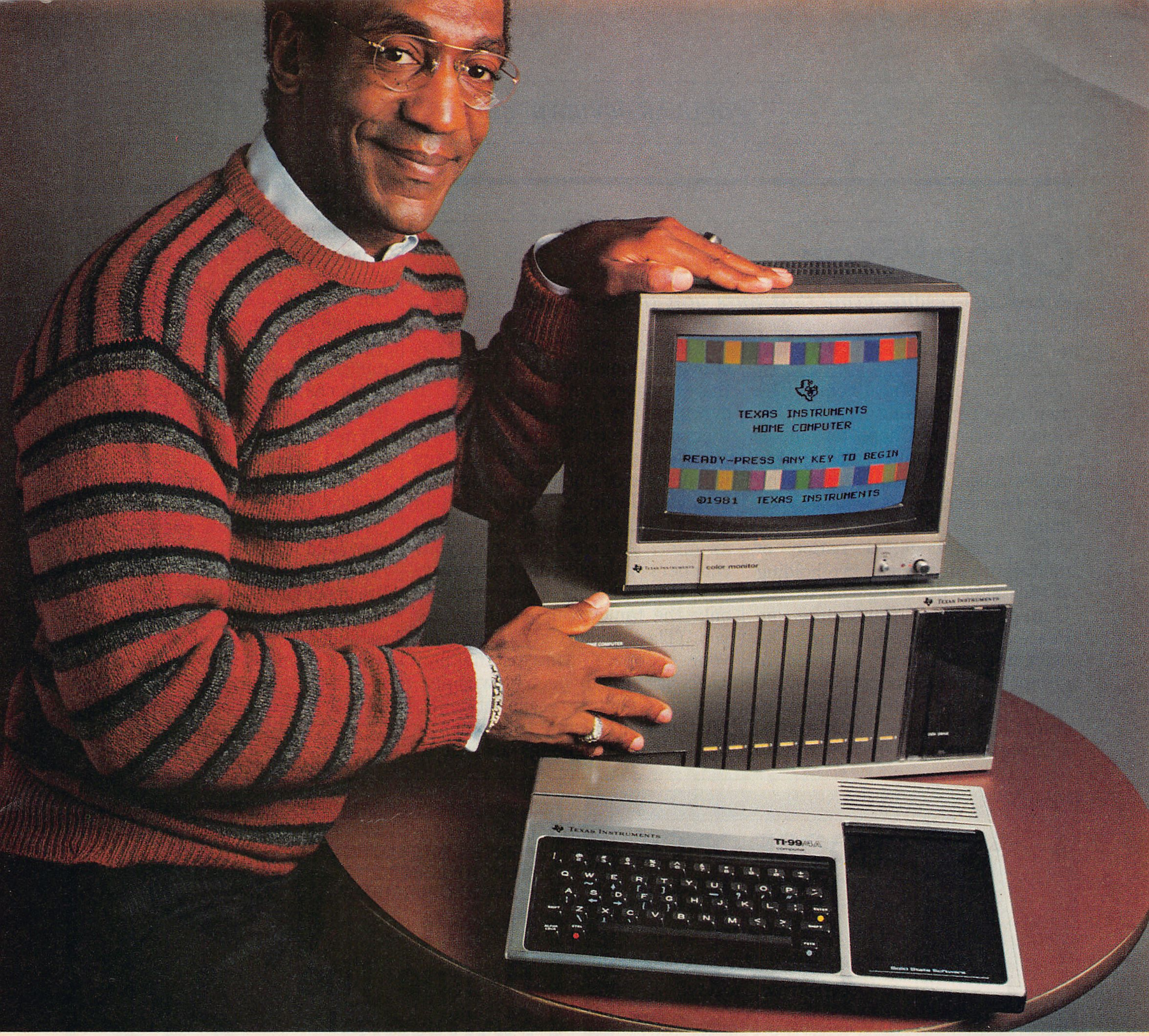

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GAMES

Choplifter

A hostage-rescue game that puts you in the pilot's seat

by Susan Ferber

Good morning, Mr. Phelps. The man you're looking at is Don Gorlin, author of Choplifter, one of the most diabolical computer games ever devised: it plays on your heartstrings as well as your mind.

The Bungelings, a nation of militaristic ideologues, are holding as hostages 64 delegates to the United Nations Conference on Peace and Child Rearing. The delegates are being detained in groups of 16 in 4 separate barracks. Your mission, should you choose to accept it, is to rescue the delegates.

Three armed helicopters will be waiting for you at the U.S. Post Office in Bungeling. You must use the choppers, one at a time, to evacuate the hostages and bring them safely back to the Post Office. Needless to say, the Bungelings will do everything in their power to stop you. Gorlin has equipped them with tanks, jet fighters, and drone air mines that can home in on your choppers with incredible accuracy.

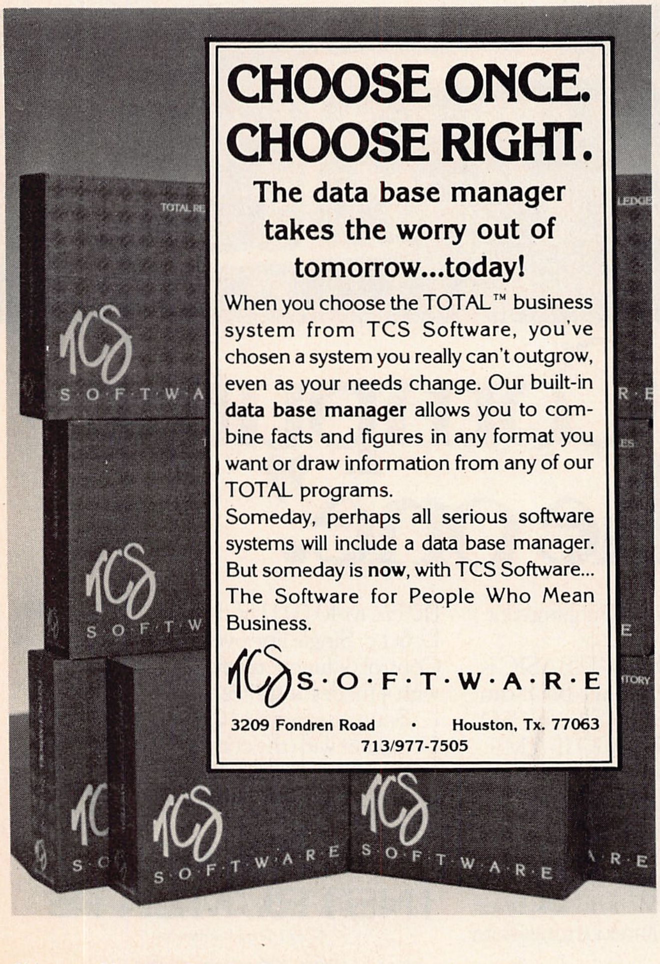
At the beginning of your mission, only the tanks will be out to get you. (They make easy targets for your choppers.) One of the barracks has already been blown open, making your first rescue attempt a relatively simple one. But don't be fooled—the Bungelings are not as stupid as their name implies. You'll probably be able to deliver only one load of hostages to safety before the Bungelings discover your plan and send out their jets. Our sources on the inside tell us you can't anticipate where or when their jets will strike. The drone air mines in their arsenal zero in on your chopper so fast that you'll have to be quick to evade them.

Your skill as a pilot will be tested as well. If you're not careful, you could crash your chopper or even land on the hostages.

A word of caution: each chopper can hold only 16 hostages. And here's where the emotional side of the game comes into play. You may be forced to leave some hostages behind. As you pull away, you watch them waving helplessly at you. Many will be killed in the crossfire. It's enough to put a lump

---

Susan Ferber is a researcher for *Popular Computing.*



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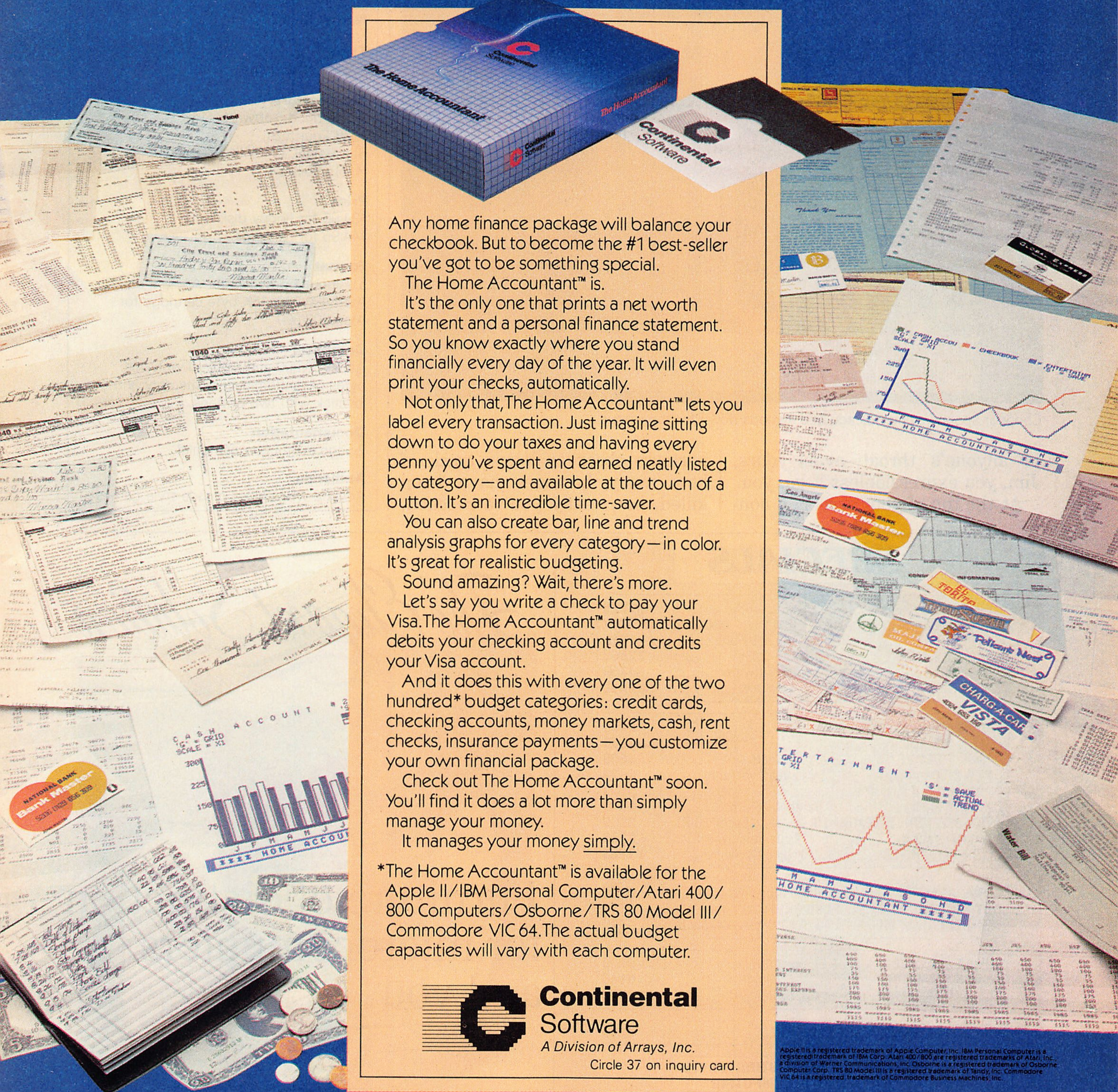

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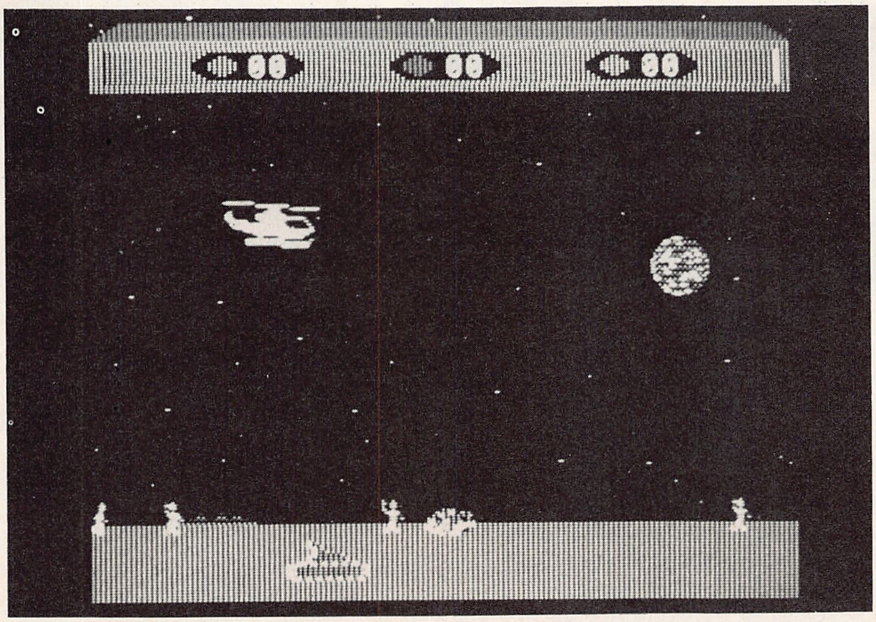

Chopper spots waving hostage and swoops down for the rescue.

in anyone's throat—even yours, Jim, you expressionless hero, you.

At the top of your screen, a nonpartisan observer keeps track of how many hostages have been killed, how many you've rescued,

At a Glance

Name: Choplifter

Type
Arcade-style game

Manufacturer
Broderbund Software
1938 Fourth St.
San Rafael, CA 94901
(415) 456-6424

Price
$34.95 for floppy disk
$44.95 for cartridge

Format
5¼-inch floppy disk for Apple II and Atari 400/800; 16K-byte cartridge for Atari 400/800

Computer
Atari 400/800 and Apple II with 48K bytes of random-access memory and joystick with two buttons

Documentation
2-page instruction pamphlet

Audience
Anyone who enjoys arcade-style games

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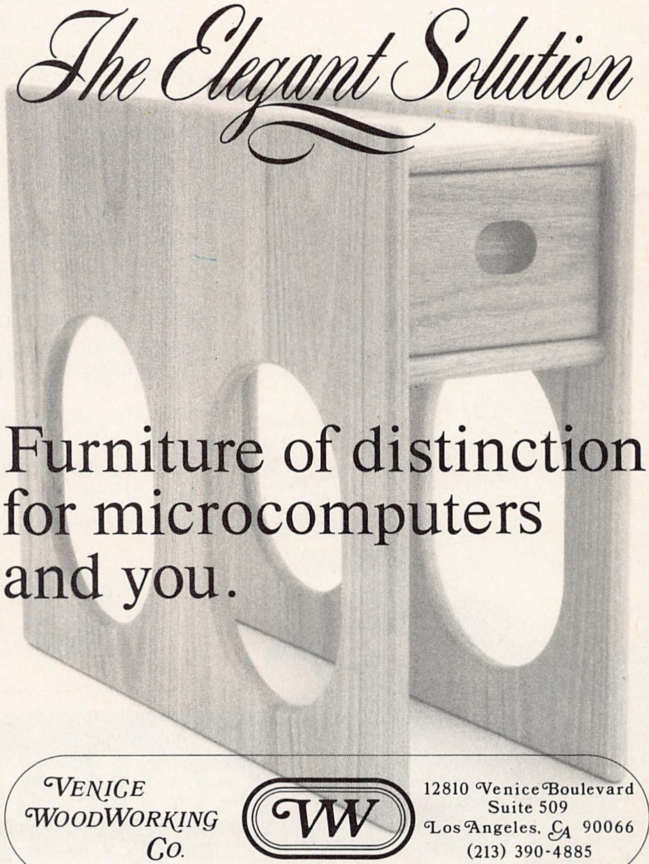

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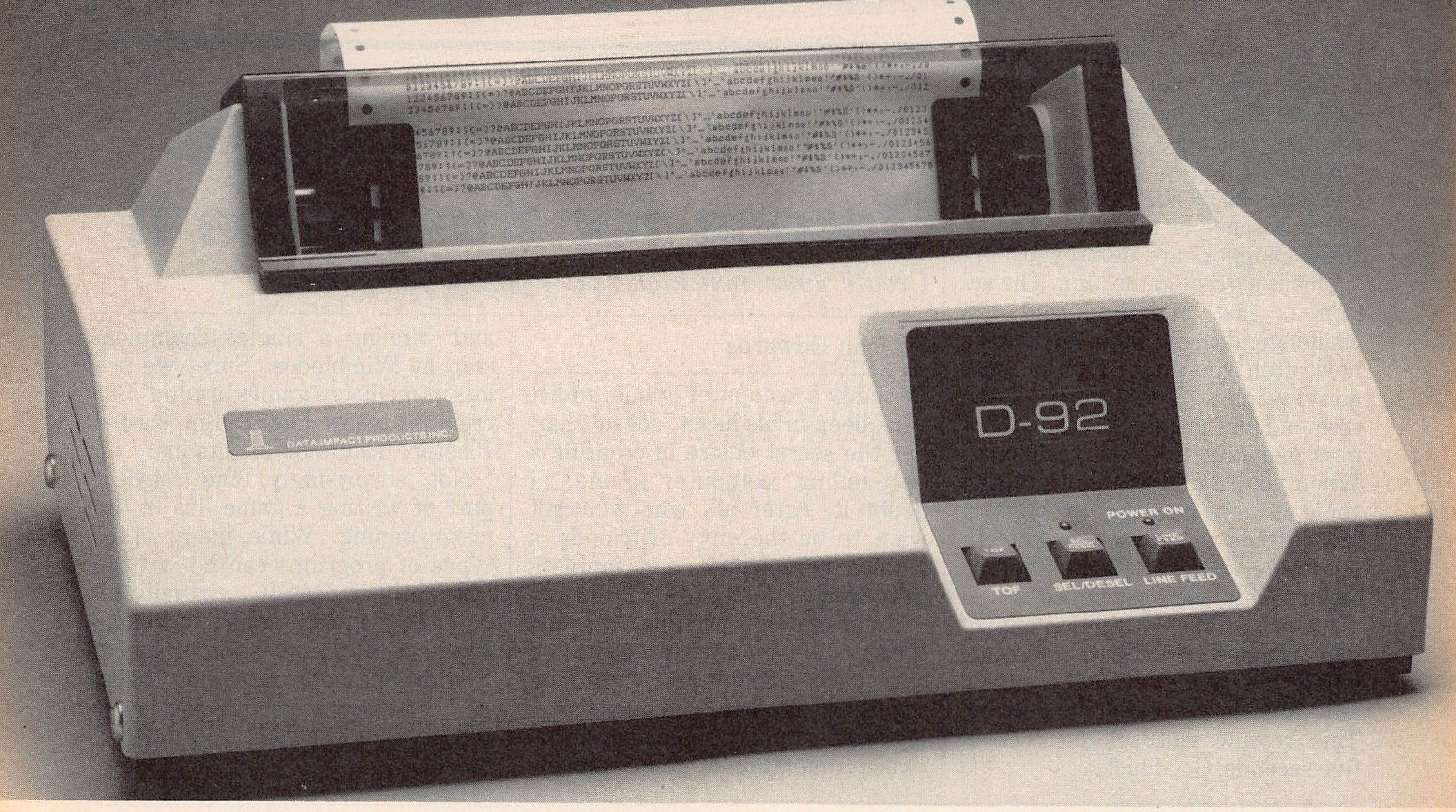

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and how many are in your chopper at any given time. Gorlin claims that no single method can rescue all the hostages, so try using various strategies. The mission will end when all 64 hostages have been either rescued or killed or when all three choppers are destroyed.

This is a great game, Jim. The action is fast and fun, and the challenge doesn't fade no matter how often you play. But the most amazing part of this game is the tremendous graphics. The choppers maneuver like the real thing. When you're finally able to return some of these hostages to safety, a few of them will pause long enough to wave their thanks before dashing into the Post Office.

As usual, should you or any of your Choplifter force be caught or killed, the secretary will disavow any knowledge of your actions. This review will self-destruct in five seconds. Good luck. □

TECHNICAL TOOL

Do-It-Yourself Arcade Games for the Apple II

Create your own high-resolution action games

by John Edwards

Is there a computer game addict who, deep in his heart, doesn't harbor the secret desire of creating a best-selling computer game? I doubt it. After all, who wouldn't want to be the envy of friends, a famous personality, and fantastically wealthy?

Unforunately, writing a good arcade-style game isn't easy. I'd say the difficulty of putting together a top-notch game package probably ranks somewhere between inventing a new medicine and winning a singles championship at Wimbledon. Sure, we see lots of mediocre games around. But creating a new Pac-Man or Raster Blaster? That's divine genius.

Not surprisingly, the hardest part of writing a game lies in the programming. While many other types of programs can be written efficiently in BASIC, virtually all popular games require machine language. It's a question of speed. Flying missiles, careening balls,

---

John Edwards, a freelance writer living in Queens, New York, is a contributing editor to *Popular Computing.*

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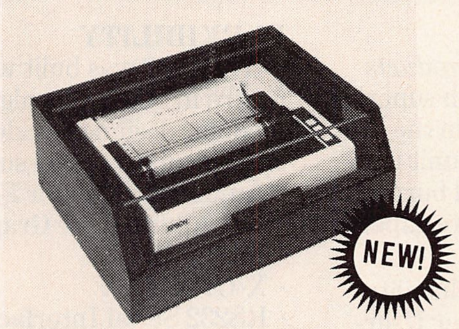

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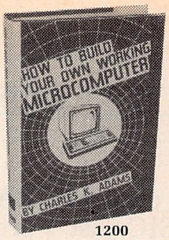
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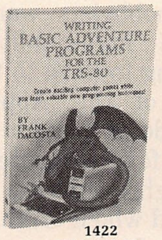
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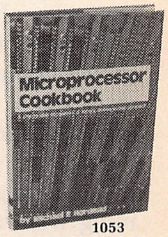
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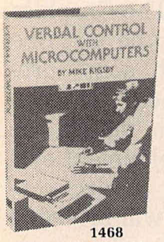
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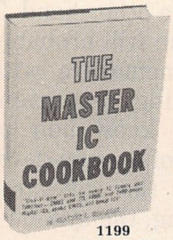
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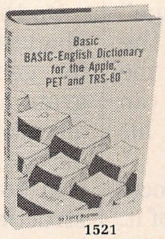
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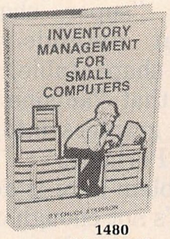
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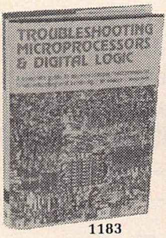
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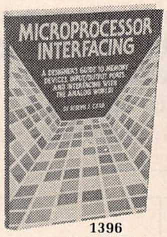
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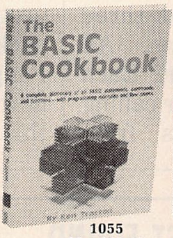
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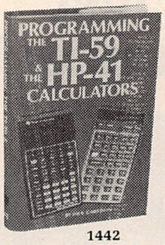
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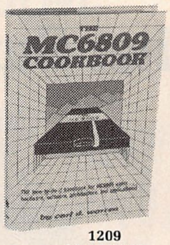
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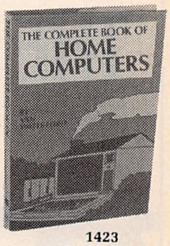
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and screaming aliens all demand rapid animation that BASIC just can't provide. Hence, if beginning computer hobbyists want to try creating a high-quality game, they're going to have to tackle the intricacies of the Apple's 6502 machine code or look for help.

Because few computerists are lucky enough to know a programming wizard who'll teach them the fine points of game programming, most budding gamemakers find help in one or more of the game-development packages that have recently appeared on the market. These packages promise a complete range of subroutines and editors that you can use to create professional-quality arcade-style games for your Apple II.

What follows is a look at three game-development systems. All work in a similar manner. Each provides the option of either calling machine-language routines from BASIC when needed or creating a program exclusively in assembly language. All claim they can be used by computerists with little or no programming background.

The Graphics Magician

The Graphics Magician ($59.95) from Penguin Software is the least expensive of the three programs. A three-part package consisting of a graphics editor, an animation system, and a "super shape" subroutine that extends the Apple's built-in shape table, the program claims that "anyone can put professional graphics into his own programs." Perhaps.

The major problem here is documentation: there's not enough of it. I'm convinced that a good graphics program lurks somewhere on this package's single disk (according to Penguin, Scott Adams based his new line of graphics adventures on this system), but beginners may have a hard time discovering how to use the program.

For instance, while the manual provides enough information on how to draw shapes and animate them, it includes precious little on how to integrate these routines into actual programs. The documentation does offer a few lines of BASIC programming to help you along, but it's not nearly enough to put the system to full use.

On the other hand, The Graphics Magician will probably be just fine for gamemakers with some programming experience. If you already know how to match the output of a game-development system to the software you're constructing, the system will probably be a great time-saver when compared to direct drawing and animation methods. The picture/object editor lets you create high-resolution images in more than 100 colors. With the package's shaping

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system you can create a new type of shape table, which includes color and angles that are preserved when you rotate shapes or scale them up or down in size. I found the animation to be smooth and easy to implement, and the images I created came out fine. The only problem was applying the results.

If you want to save money and have a moderately technical background, The Graphics Magician may be for you. Others, beware.

Hi-Res Secrets

Hi-Res Secrets from Avant-Garde Creations offers something that's missing from both of the other game tools reviewed here: sound. Think about it. No arcade game worth its salt has anything less than a stunning audio track. Yet none of the other "complete" game systems I've seen even mention sound in their documentation, much less tell you how to program it. Hi-Res Secrets does both. While not comparable to any of the music-only editors currently available, the system does let you supply a wide array of sound effects. You're able to whip together subroutines that can do anything from playing "Yankee Doodle" on a violin to imitating a foghorn.

Of course, Hi-Res Secrets is primarily a graphics-oriented program, and in this capacity it excels. The four-disk package and its documentation offer a thorough tutorial in arcade-game design. Given enough time and a modicum of effort, just about any Apple owner should be able to create a broad range of games with this package.

Hi-Res Secrets' secret to success is its building-block approach. The documentation slowly unfolds the system's various features and the world of game programming as a whole. Initially, you're encouraged to get your feet wet by experimenting with elementary tasks such as drawing simple designs and filling them in. Later, you're shown how to animate those drawings and incorporate them into completed games. Written in a breezy, conversational style, the documentation reads well enough to stand on its own as an introduction to graphics programming.

One feature I found particularly handy was Superfont, a graphics-titling utility that adds a professional touch to any game. This program helps you create a stunning array of title pages, captions, and text with great ease.

Hi-Res Secrets does have a few drawbacks. The documentation is sometimes too cute (at times you have to reread it) and could benefit from tighter organization. And you'll need an outside assembler to modify many of the system's machine-language programs. But these are minor points. Hi-Res Secrets is first-rate, perfect for beginners and pros alike.

A2-3D1 Graphics Package

It may not have the catchiest name ever attached to a software product, but for its specialized application, Sublogic's A2-3D1 Graphics Package might be the best game package going.

The first thing you'll notice about this product is its massive size.

At a Glance

Name: The Graphics Magician

Type
Computer graphics and animation system

Manufacturer
Penguin Software
830 4th Ave.
Geneva, IL 60134
(312) 232-1984

Price
$59.95 for joystick/paddle version
$69.95 for graphics-tablet version

Format
5¼-inch floppy disk

Computer
Apple II with 48K bytes of random-access memory

Documentation
32-page manual; 12-page tutorial

Audience
Hobbyists interested in creating their own arcade games

Name: Hi-Res Secrets

Type
Computer graphics, animation, and sound system

Manufacturer
Avant-Garde Creations
POB 30160
Eugene, OR 97403
(503) 345-3043

Price
$125

Format
5¼-inch floppy disk

Computer
Apple II with 48K bytes of random-access memory

Documentation
263-page vinyl binder

Audience
Hobbyists interested in creating their own arcade games

Name: A2-3D1 Graphics Package

Type
Computer graphics and animation system

Manufacturer
Sublogic Communications Corporation
713 Edgebrook Dr.
Champaign, IL 61820
(217) 359-8482

Price
$119.85

Format
5¼-inch floppy disk

Computer
Apple II with 48K bytes of random-access memory

Documentation
283-page vinyl binder (technical information); 32-page tutorial

Audience
Hobbyists interested in creating their own arcade games

Most of its bulk comes from the system's extremely thorough documentation. While not written in the same tutorial style as Hi-Res Secrets' instructions, A2-3D1's documentation is logically arranged and affords its readers a very detailed look into the program's operation.

Besides its documentation, what makes the A2-3D1 system so good is its classy animation system—far superior to anything else available. If you've ever used Sublogic's Flight Simulator program, you know the sort of sophisticated three-dimensional graphics this company is famous for. A2-3D1 incorporates all these wonderful graphics—including zoom-ins and super-smooth animation. And the superb documentation makes the task of implementing these advanced features relatively painless.

The A2-3D1 package lets you generate shapes efficiently from the Apple's keyboard with a minimum of fuss and bother, and its view-finder program helps you analyze your creations from different angles at any time during development. The program also includes a special subroutine that allows you to orbit your scene. It's the sort of stuff that even the most jaded computerists can thrill to.

Unfortunately, this type of package has some disadvantages, and A2-3D1's greatest failing lies in its inability to "paint" objects. Because the program emphasizes three-dimensional representations, images exist only as bare outlines, and it's virtually impossible to form any solid graphics. Hence, A2-3D1 is outstanding for game applications that require a three-dimensional effect (flying through space, rotating objects, and the like), but I wouldn't necessarily want to use it to design a pinball game or high-resolution adventure.

Some Reflections

While all these products more or less deliver what they promise, what bothers me is their claim that they let beginners create professional computer games with minimal effort. That's just not true.

These systems must be viewed as programming tools, not magic potions that instantly transform novices into master game builders. As tools, these products can't accomplish anything unless used by someone who knows what to do with them. Game-development systems let users with prior programming knowledge speed through repetitive and time-consuming chores such as manually plotting out and animating graphics objects. Beginners, though, will have to spend many hours poring through both documentation and outside reading material before they can feel comfortable with any of these products. ☐

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Computer Algorithms

Breaking problems into computer-solvable parts

How to Solve It by Computer

R. G. Dromey
Prentice-Hall
Englewood Cliffs, NJ, 1982
400 pages, softcover $16.95
Reviewed by Jonathan Amsterdam

In the 1940s, the mathematician George Polya published *How to Solve It,* a book in which he tried to explain how mathematicians solve problems. Instead of presenting mathematical theorems and their proofs in the usual form—all neat and tidy with no loose ends—Polya showed how the theorems were developed, from the beginning of the creative process to the end. Now R. G. Dromey has done the same for computer algorithms with his book, *How to Solve It by Computer.* Algorithms—or problem-solving procedures—have always been important in computer science because everyone who uses computers has problems to solve and wants to solve them quickly and economically. But whereas traditional computer science textbooks present algorithms in their full-fledged, adult state without much explanation of how they were developed, Dromey's book leads the reader through the entire design process.

The first chapter of the book contains some general observations on problem solving by computer and on how to analyze algorithms and prove that they're correct. Dromey's discussion of problem solving is excellent. He talks about the difference between doing a complicated task on our own—like looking up a telephone number in a phone book—and programming a computer to do the same task:

> *Tasks such as this are usually performed automatically without any thought to the complex underlying mechanism needed to effectively conduct the search. It therefore comes as somewhat of a surprise to us when developing computer algorithms that the solution must be specified with such logical precision and in such detail. After studying even a small sample of computer problems it soon becomes obvious that the* conscious *depth of understanding needed to design effective computer algorithms is far greater than we are likely to encounter in almost any other problem-solving situation.*

Dromey goes on to tell us how to begin thinking about a problem. The first thing to do is to define the problem clearly. To get started on solving it, make up some simple examples and try to work on them. It helps to use our store of past experience, but Dromey warns that we should place "only cautious reliance on past experience. In trying to get a better solution to a problem, sometimes too much study of the existing solution or a similar problem forces us down the same reasoning path (which may not be the best) and to the same dead end."

Although such generalities are interesting, they're not very helpful. The book really shines in the remaining chapters in which Dromey applies these techniques to 50 algorithms. These discussions are the best part of the book—and the most exciting. He begins each discussion with the statement of a problem—like "count the number of times a particular word occurs in

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Jonathan Amsterdam works in the Artificial Intelligence Lab at the Massachusetts Institute of Technology.

Illustration by Wilbur Bullock

a given text"—and then develops a procedure to solve the problem, explaining each step along the way and using some of the techniques mentioned above. And Dromey doesn't stop there. After deriving a method to solve a problem, he almost always asks how the algorithm can be made more efficient or easier to program. Only after he's satisfied that the procedure is a good one does he actually write it out step by step, first in a very readable English description, then as a Pascal program. Following each program are additional notes about the algorithm, sometimes including a proof of its correctness and a derivation of its *complexity*—the computer scientist's measure of efficiency. Several exercises follow the notes, some suggesting further improvements and variations, some pointing out similarities to other problems.

Dromey devotes between 5 and 10 pages to each algorithm. He divides the 50 algorithms into 7 chapters, each covering a different class of procedures. The first chapter, "Fundamental Algorithms," is a grab bag of simple algorithms. Later chapters discuss factoring methods, array techniques, sorting and searching, text processing and pattern searching, dynamic data structures, and recursion. At the end of each chapter Dromey includes a list of references that cite the important work done on that class of algorithms.

This organization makes it easy to browse through the book. Because it's almost always possible to learn an algorithm without knowing about most others, you can read the book in bite-sized chunks. Each section contains something for almost any interested reader. If you're just looking for a fast sorting algorithm, you can turn to the section on quicksort and copy the Pascal program given there without worrying about how quicksort was invented or why it's so quick. If you want to understand how the algorithm works, read the discussion that begins the section. If you'd like to test your understanding, try some of the exercises.

If I've made this book sound like a bed of roses, let me add that it is definitely not for the mathematically squeamish. Dromey intended the book as a text for an introductory college-level course, and although he doesn't assume that the reader has much mathematical knowledge, he does use mathematics freely and without warning. If you don't know what "logarithm to the base two" means and the words "probabilistic average case analysis" turn your stomach, you might be in for a rough time. And even though you may feel moderately confident about your

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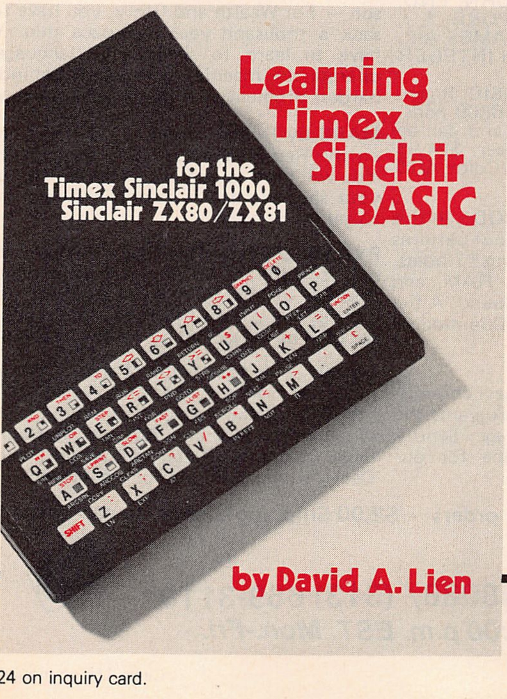

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mathematical ability, some sections of the book—like the section on proving algorithms correct—will surely challenge you if you don't have a fairly strong mathematical background.

On the bright side, Dromey confines most of the mathematically fancy stuff to chapter one, to some of the algorithms in chapters two and three, and to the notes on each algorithm. The discussion section of most of the algorithms is safer ground.

One other problem for the unwary reader: Dromey assumes you have at least a reading knowledge of Pascal. If you've had no programming experience at all, you'll have to ignore the Pascal programs provided with each algorithm, as well as the bits and pieces of Pascal placed here and there in the discussions. You may still find the book interesting, but it won't be a picnic, and you won't get everything the book has to offer. If you've had some experience programming in BASIC, you'll have a decent chance of understanding most of what's presented, but it's probably a good idea to learn a little Pascal first. This book would make a great second book on Pascal—once you've learned the basics of the language, you could pick up many of the advanced concepts here.

One last caveat for the hardy few who remain: *How to Solve It by Computer* is a text, so the writing style tends to be a little dry. It's quite readable, just not as snazzy as many of the books you can find in your local computer store.

In case you haven't guessed already, this book is not for the casual reader. If you're not comfortable with mathematics and don't know Pascal, it's probably not for you. But if you feel you're up to it, then I highly recommend *How to Solve It by Computer.* It is sure to find a permanent place on your computer bookshelf, as it has on mine.

Data Processing An Introduction with BASIC, 2nd edition

Donald D. Spencer
Charles E. Merrill Publishing Co.
Columbus, OH, 1982
544 pages, softcover, $18.95
Reviewed by Doug Garr

Data Processing is a good example of what's bad about most computer books. The author's prose is dense, impersonal, and often so unclear that the book is virtually useless as a text (each chapter features review questions, so I assume the book was meant as a text). Moreover, Spencer tries to cover far too much ground for one volume. It's difficult to tell whether a precocious seventh grader or a college business major would better bene-

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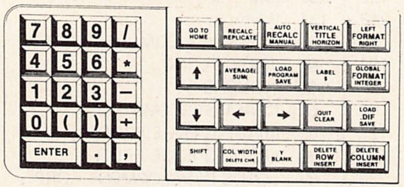
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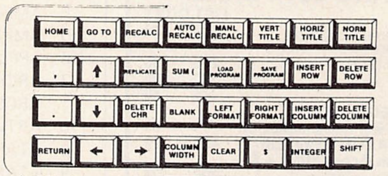
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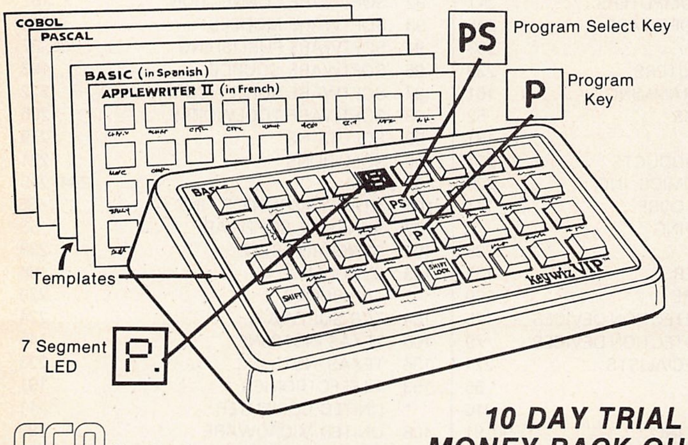
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fit by plowing through these muddled pages.

Trying to learn anything substantial by reading *Data Processing* is like buying a Commodore VIC-20 and planning on trading up to a Grid Compass in two weeks. It just cannot be done. The subheads, key phrases in boldface type, and hundreds of illustrations—in short, all of the textbook publisher's tricks of the trade to make learning easier—do nothing to help the reader get a firm grasp of what a microprocessor does.

Illustrating a book like this is difficult for any editor. After all, how many times can you show a picture of a cathode-ray tube? Your basic integrated circuit isn't very spectacular, either. Yet I don't think a computer book serves anyone's interests when it contains two identical photos of a jet plane to explain the fairly obvious fact that modern aircraft don't travel anywhere without the aid of microprocessors.

Poor organization plagues the book. It's especially distracting when the author uses a phrase on page 9—assuming the reader understands its meaning—and then finds it necessary to define the phrase on page 106 (as Spencer does with "integrated circuits"). Even the glossary and index won't do you much good with a text as disorganized as this one is, despite its lengthy table of contents that attempts to classify computers in digestible chunks.

Occasional generalizations and inaccuracies pop up in various chapters. It's insulting to be asked to believe that computers have guided astronauts to faraway planets. (Has man landed on some celestial body other than the moon?) Spencer also claims that "no one has yet lost a job to a robot," a statement I take issue with. True, robots may ultimately provide more jobs than they eliminate. But try arguing that point now with the General Motors welder who just lost his job to a Unimation arm.

You might argue that these are minor points and that even a few quibbles don't spoil an otherwise good book. This text doesn't fall in that category. Most of Spencer's book dotes on the esoteric facts of the computer industry: what "remote batch terminals" are, what a systems analyst does, and so on. None of this information is crucial if the reader doesn't even know where the On button is.

I had hoped that Part 4, which discusses programming in BASIC, would at least give the adventuresome person a reason to buy this book. But Spencer's prose is hardly a substitute for plugging a computer into an outlet, turning it on, and firing away. This is not the text to turn to after you first experience the terror of seeing "syntax error" on the screen.

How to Break into Data Processing

Laura Steibel Sessions
Prentice-Hall
Englewood Cliffs, NJ, 1982
179 pages, hardcover $12.95
softcover $6.95
Reviewed by Rachael Wrege

So, you're hooked. Those intriguing hours at the keyboard have you dreaming of computing all day—and making a profitable living as well. You're starting to imagine a career as a programmer, a systems analyst, a data processing (DP) manager perhaps. But how do you get there?

Good question, and we've got an even better answer. *How to Break into Data Processing* is a handy little guide packed with hints, tips, and practical information for those lured by a booming industry that promises to get even bigger in the next decade. Laura Steibel Sessions is a professional DP recruiter (with the Robert Half Agency on

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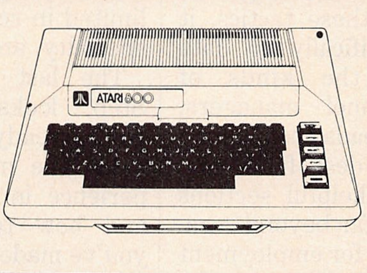

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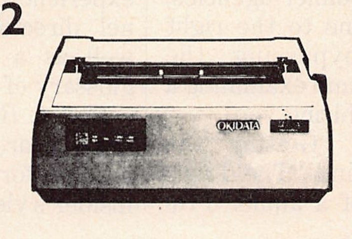

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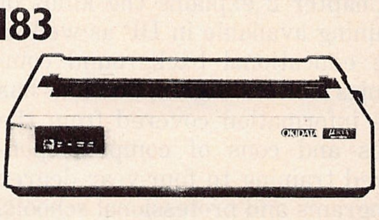

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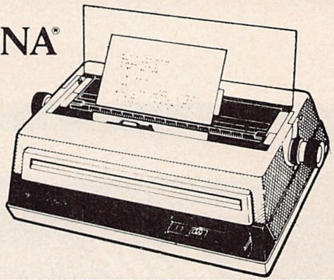

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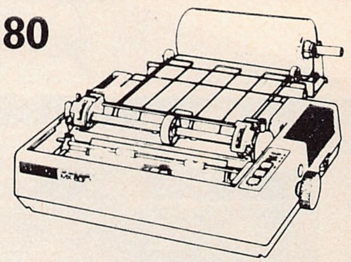

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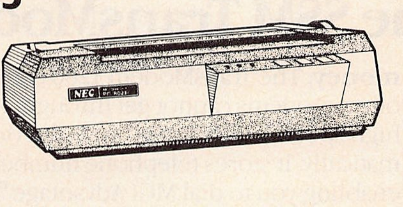

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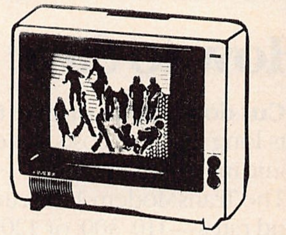

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Long Island), and she knows what she's talking about—she places entry-level and more highly skilled personnel inside the companies you're longing to join.

How to Break into Data Processing addresses the needs of students, first-time job seekers, and even those just mulling over data processing as a career. It starts off with a bird's-eye view of the industry at large, the potential for growth in both large and small companies, and the assorted job titles and functions that come with the territory—from programming and operations specialties to management and DP auditing.

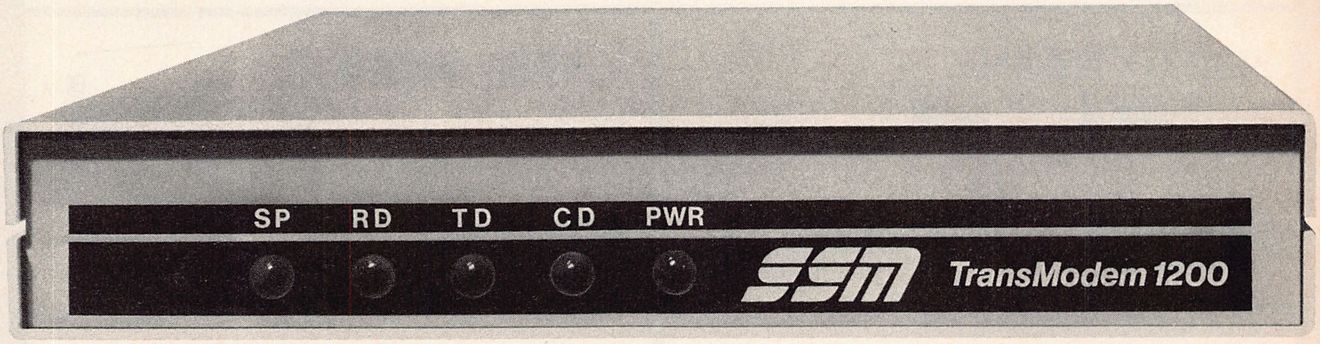
Chapter 2 explains the kinds of training available in DP as well as the educational background companies look for. Again, Sessions has the information covered from the pros and cons of company-sponsored training to four-year degree programs and professional schools.

As you might expect, most of the book focuses on how to get your first job in data processing (Sessions is, after all, a personnel recruiter). But this is no ordinary career guide on how to write a resume, sell yourself, or get and handle an interview. Although the book includes all these tactics, it tailors them specifically to data processing and the kinds of recruiters, personnel managers, and department heads that will be sitting across the desk from you. One of the most helpful sections takes job hunters far beyond scanning the classifieds for employment leads to making contacts in the industry, using personnel agencies, getting your resume to the right manager (and bypassing the resume trash can), and examining a firm's motives for hiring you.

Chapters titled "Getting the Right First Job" and "The Trials and Tribulations of a Junior Programmer" give insightful pointers on building career goals and paths when you're just starting out. Like the rest of the book, these chapters are filled with sample scenarios of people who have turned an entry-level job into a critical position in the company, made a job that was limited in scope into a marketable specialty, and more.

The last chapter, "The Next Step," looks at what to do when you're ready to move on, how to make the most of your first experience in DP on your resume, and how to mine the contacts you've made. An appendix includes quotes from people recently hired, experienced programmers, personnel directors, and managers, as well as a sample resume and a glossary of DP terms.

How to Break into Data Processing is clear, concise, and well worth its price for the sound guidance and insider's view it provides. □



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Pick a Card—Any Card

A new department featuring programs and problems for fun and profit

by Michael W. Ecker

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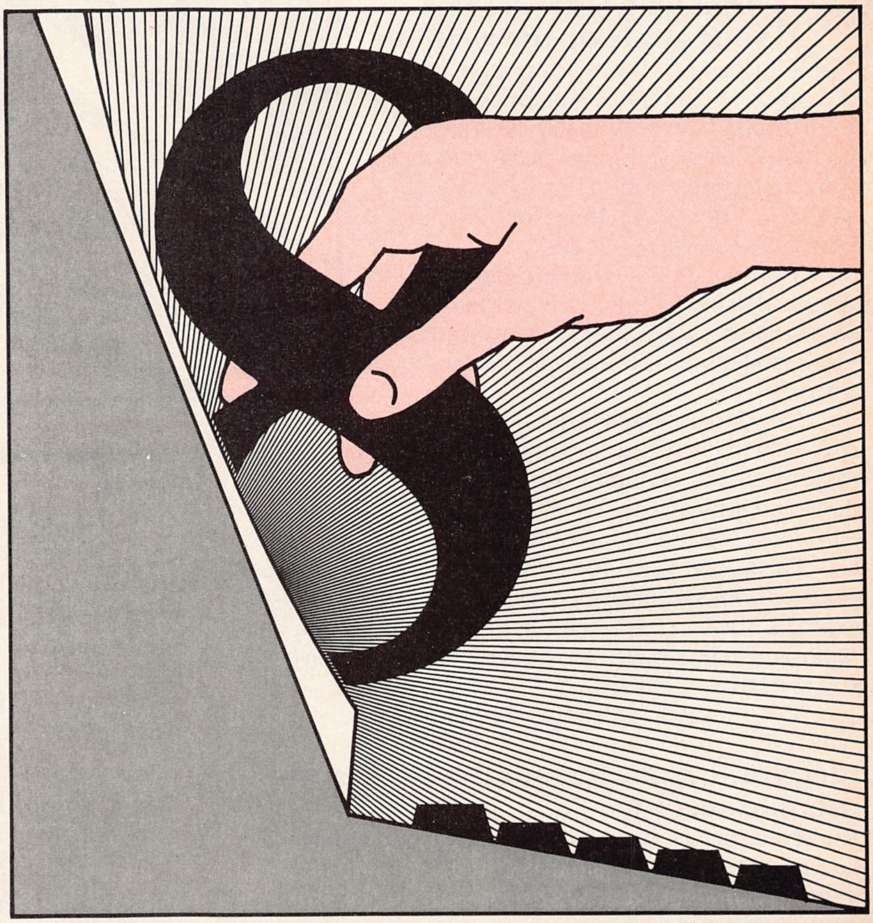
And now, on to our first project.

A Card Trick

In this trick, you start by choosing a number from 1 to 63 ("pick a card—any card"). The computer will present you with a series of displays, asking you each time whether your number is contained in the display. Each display includes 32 numbers.

After you have examined six displays, the computer will tell you your original number. If you have answered the yes/no questions truthfully, the computer will always be right. (This is assuming, of course, that you have typed the program in carefully and eliminated any typing errors.)



Go ahead and type in the program given in listing 1. It is written in Microsoft BASIC for the TRS-80 Model III. It should run with only minor modifications in other versions of BASIC.

How, you ask, can the machine consistently guess the right answer after only six selections? I'll leave this question for you to mull over until we return to it next time.

I would also like to share a puzzle dubbed The Eccentric Jailer. The problem has appeared of late in some mathematics journals, but it is evidently not widely known.

An eccentric jailer has 100

Michael W. Ecker is assistant professor of mathematics at the Worthington Scranton campus of Pennsylvania State University.

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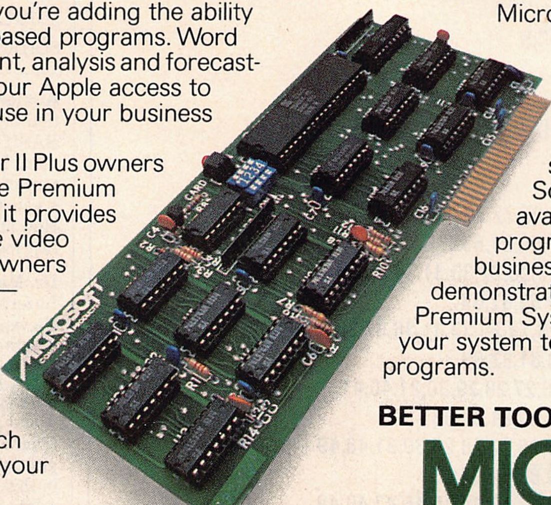

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prisoners in 100 cells numbered 1 through 100, one prisoner per cell. Initially, all the cells are closed. The jailer offers the following partial amnesty: every second, certain cells will be reversed from open to closed or vice versa. Specifically, at the first second every cell is reversed, so all are now open. At the next second, cells number 2, 4, 6, 8, . . . , i.e., all cells whose numbers are multiples of 2, are reversed, in this case to be closed. At the third second, all cells with numbers that are multiples of 3, such as 3, 6, 9, 12, etc., are again reversed. In general, at second number *k*, the status of every cell whose number is a multiple of *k* is reversed. This is continued for a total of 100 seconds, and nobody can leave during this time.

Listing 1: This BASIC program performs a "card trick" on your computer's display.

```
10 REM – BASE 2 CARD TRICK
20 REM – BY MICHAEL W. ECKER,
30 REM – SCRANTON, PA.
40 RESTORE:REM INITIALIZE DATA TABLE
45 PRINT
50 PRINT"BASE 2 CARD TRICK"
55 PRINT
60 PRINT"PLEASE THINK OF A WHOLE NUMBER FROM 1 TO 63"
70 PRINT:FOR Z=1 TO 800:NEXT Z:REM TIME DELAY
80 PRINT:PRINT:PRINT
90 INPUT"PRESS <ENTER> (OR RETURN) TO CONTINUE";X$
100 PRINT
110 S=0
120 FOR J=1 TO 6
130 T=1
135 PRINT TAB(5);
140 FOR K=1 TO 32
150 READ A
180 IF A<10 THEN PRINT A;"   ";:GOTO 200:REM 3 SPACES IN QUOTES
190 PRINT A;"  ";:REM 2 SPACES IN QUOTES
200 IF K=4*T THEN PRINT:PRINT TAB(5);:T=T+1
210 NEXT K
220 PRINT
230 INPUT"DOES YOUR NUMBER APPEAR ON SCREEN (Y OR N)";N$
240 IF N$="Y" THEN S=S+2[(J–1):REM "[" IS EXPONENTIATION
250 IF N$<>"Y" AND N$<>"N" THEN GOTO 230
260 N$=" ":REM ONE SPACE
270 NEXT J
280 PRINT
290 FOR Z=1 TO 500:NEXT Z
300 PRINT"OKAY, CONCENTRATE VERY HARD NOW..."
310 PRINT"I AM READING YOUR MIND..."
320 FOR Z=1 TO 800:NEXT Z
330 PRINT:PRINT:PRINT"YOUR NUMBER IS ";S
340 FOR Z=1 TO 500:NEXT Z
350 PRINT
360 INPUT"DO YOU WISH TO PLAY AGAIN (Y OR N)";X$
370 IF X$="Y" THEN GOTO 40
380 GOTO 510
390 DATA 1,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37
400 DATA 39,41,43,45,47,49,51,53,55,57,59,61,63
410 DATA 2,3,6,7,10,11,14,15,18,19,22,23,26,27,30,31,34,35,38
420 DATA 39,42,43,46,47,50,51,54,55,58,59,62,63
430 DATA 4,5,6,7,12,13,14,15,20,21,22,23,28,29,30,31,36,37,38
440 DATA 39,44,45,46,47,52,53,54,55,60,61,62,63
450 DATA 8,9,10,11,12,13,14,15,24,25,26,27,28,29,30,31,40,41
460 DATA 42,43,44,45,46,47,56,57,58,59,60,61,62,63
470 DATA 16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,48,49
480 DATA 50,51,52,53,54,55,56,57,58,59,60,61,62,63
490 DATA 32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49
500 DATA 50,51,52,53,54,55,56,57,58,59,60,61,62,63
510 END
```

The warden says that any con in a cell that is open at the end of the 100 seconds may leave, but how generous an amnesty is this? How many cells are open at the end? Which cells are these?

As an example, consider cell number 6. Initially closed, it is opened the first second, closed the next second, opened again the third second, unchanged during the fourth and fifth seconds (why?), and finally closed again at the sixth second, never to be opened again.

So, your challenge is to write a BASIC program to solve the problem. This program should be sufficient to determine a clear pattern. Once you have done this, can you explain, as a mathematical challenge, the reason for the pattern? Next time we'll look at one solution and perhaps expand to some related questions. ☐

Author's Note—Do you have an interesting question or favorite puzzle? Perhaps you can write a BASIC program superior to one used in this column. Maybe you know something about the history of a problem discussed here or can contribute a generalization, special case, or related problem. How about letting us know? Please feel free to contact me directly:

Dr. Michael W. Ecker
Luzerne 8
Viewmont Village
Scranton, PA 18508

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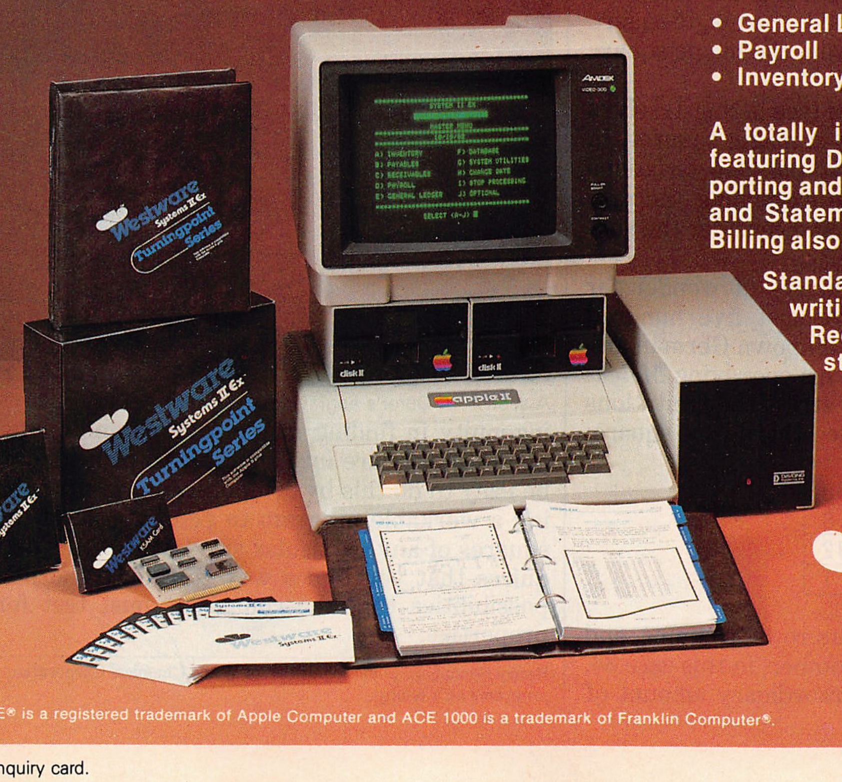

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THE PROGRAM FACTORY

Magic Squares Revisited

Get ready for the ultimate challenge in constructing magic squares

by Henry Sonneborn

A recent Program Factory article by Andy Hennigan (see January 1983, "Magic Squares," page 155) presents a BASIC program for calculating a single example of each size of odd-order magic squares from 3 by 3 to 29 by 29. Mr. Hennigan based the program on an algorithm described in the book *The Wonders of Magic Squares* by Jim Moran (Vintage Books/Random House, 1982). Unfortunately, the algorithm and its computer program do not work for even-order squares. In fact, Mr. Moran says, "The construction of even-order magic squares is a brand-new and completely different ball game—more mysterious, more fascinating, and more challenging."

(A magic square is an m by m array of integers from 1 to m^2 such that each row, column, and diagonal adds up to the same number. If m is odd, the magic square is said to be odd-order; if m is even, the magic square is said to be even-order.)

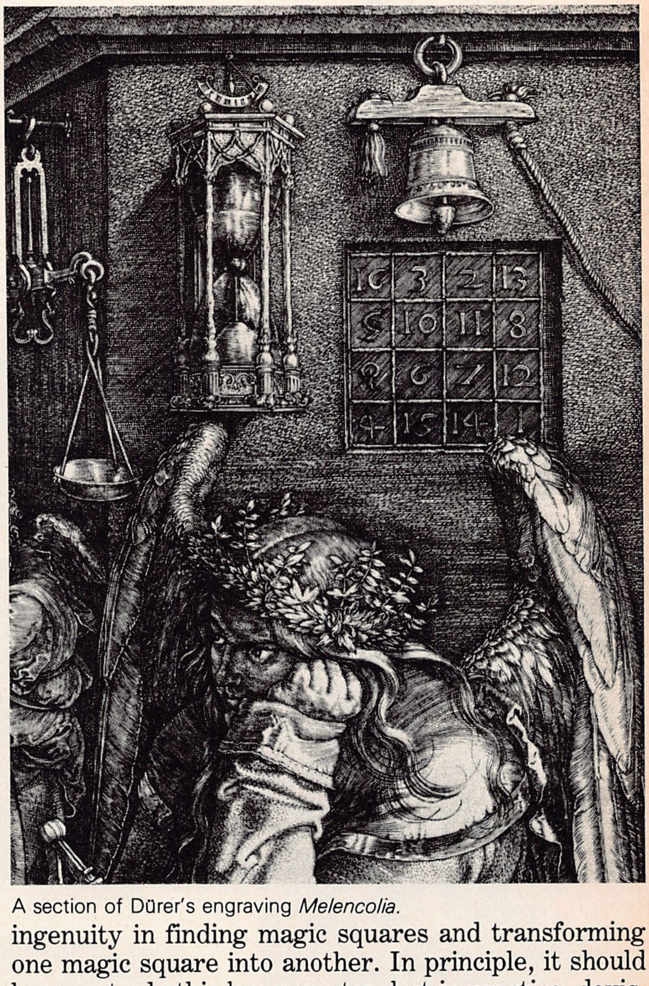
The main program in this article (see listing 1) solves the even-order problem for 4 by 4 magic squares; in principle, it is capable of finding *all* possible variations of 4 by 4 magic squares. Before examining the program, let us step back a moment and consider the subject as a whole.

Magic squares have been a source of wonder for more than a thousand years. Almost five hundred years ago, Albrecht Dürer, a well-known German artist, inserted a magic square into his engraving *Melencolia,* which otherwise seems to stress the limitations of the human intellect. Dürer used this 4 by 4 square:

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

Like all magic squares, each of its rows, columns, and diagonals adds up to the same number, in this case 34.

People have expended an extraordinary amount of ingenuity in finding magic squares and transforming one magic square into another. In principle, it should be easy to do this by computer, but in practice, devising a workable program to generate all of the magic squares of any particular size is difficult. The task requires that you find a way to reduce the number of possibilities that the computer must test for magic properties.


A section of Dürer's engraving *Melencolia.*

Henry Sonneborn is vice-chairman of Witco Chemical Corporation. He writes programs as a hobby.

Listing 1: A BASIC program that generates all 4 by 4 even-order magic squares.

```
9   PRINT
10  PRINT
11  PRINT"            4×4"
12  PRINT"        MAGIC SQUARE"
13  PRINT"            SEARCH"
14  PRINT
15  PRINT"THE RANGE OF NUMBERS USED"
16  PRINT"BY THE SEARCH CAN BE CHANGED"
17  PRINT"BY ALTERING LINES 130 AND 150."
18  PRINT"EXAMPLE:"
19  PRINT"TO CHANGE THE RANGE TO 8, TYPE"
20  PRINT"<BREAK>"
21  PRINT"130 FOR A=1 TO 8 <ENTER>"
22  PRINT"150 FOR B=1 TO 8 <ENTER>"
23  PRINT"RUN <ENTER>"
24  PRINT"PRESS <ENTER> TO CONTINUE";
25  INPUT X$
30  PRINT"AT ANY TIME DURING THE COMPUTA-"
31  PRINT"TION OF THE SQUARE, YOU CAN SEE"
32  PRINT"HOW MANY SQUARES IT HAS FOUND"
33  PRINT"AND HOW MANY POSSIBILITIES IT"
34  PRINT"HAS GONE THROUGH BY DOING THE"
35  PRINT"FOLLOWING:"
36  PRINT"<BREAK>"
37  PRINT"PRINT CT,KT"
38  PRINT"THEN TYPE 'CONT <ENTER>' WHEN"
39  PRINT"YOU'RE READY TO RESUME."
40  PRINT"CT=# OF SQUARES FOUND"
41  PRINT"KT=# OF POSSIBILITIES TRIED"
43  PRINT"THE COMPUTATION TIME IS APPROX."
44  PRINT"1 MAGIC SQUARE PER HOUR."
46  PRINT"COMPUTING . . ."
90  DIM T(20),S(20)
100 FOR X=1 TO 20
110 T(X)=0:S(X)=0
120 NEXT X
130 FOR A=1 TO 16
140 T(A)=1
150 FOR B=1 TO 16
160 IF T(B)=1 THEN 920
170 T(B)=1
180 FOR C=1 TO 16
190 IF T(C)=1 THEN 900
200 IF (A+B+C)>33 OR (A+B+C)<18 THEN 900
210 T(C)=1
220 FOR E=1 TO 16
230 IF T(E)=1 THEN 880
240 T(E)=1
250 FOR F=1 TO 16
260 IF T(F)=1 THEN 860
270 T(F)=1
280 FOR I=1 TO 16
290 IF T(I)=1 THEN 840
300 T(I)=1
310 FOR J=1 TO 16
330 IF T(J)=1 THEN 810
340 T(J)=1
350 D=34-A-B-C
360 S(D)=1
370 M=34-A-E-I
380 IF M<1 OR M>16 THEN M=20:GOTO 780
390 IF T(M)=1 OR S(M)=1 THEN 780
400 S(M)=1
410 G=34-D-J-M
420 IF G<1 OR G>16 THEN G=20:GOTO 780
430 IF T(G)=1 OR S(G)=1 THEN 780
440 S(G)=1
450 H=34-E-F-G
460 IF H<1 OR H>16 THEN H=20:GOTO 780
470 IF T(H)=1 OR S(H)=1 THEN 780
480 S(H)=1
490 N=34-B-F-J
500 IF N<1 OR N>16 THEN N=20:GOTO 780
510 IF T(N)=1 OR S(N)=1 THEN 780
520 S(N)=1
530 O=(34+A-C+F-G-M-N)/2
540 IF O<1 OR O>16 THEN O=20:GOTO 780
550 IF T(O)=1 OR S(O)=1 THEN 780
560 S(O)=1
570 K=34-C-G-O
580 IF K<1 OR K>16 THEN K=20:GOTO 780
590 IF T(K)=1 OR S(K)=1 THEN 780
600 S(K)=1
610 L=34-I-J-K
620 IF L<1 OR L>16 THEN L=20:GOTO 780
630 IF T(L)=1 OR S(L)=1 THEN 780
640 S(L)=1
650 P=34-M-N-O
660 IF P<1 OR P>16 THEN P=20:GOTO 780
670 IF T(P)=1 OR S(P)=1 THEN 780
680 IF D+H+L+P<>34 THEN 780
690 IF A+F+K+P<>34 THEN 780
700 PRINT TAB(2);A;TAB(6);B;TAB(10);C;TAB(14);D
710 PRINT TAB(2);E;TAB(6);F;TAB(10);G;TAB(14);H
720 PRINT TAB(2);I;TAB(6);J;TAB(10);K;TAB(14);L
730 PRINT TAB(2);M;TAB(6);N;TAB(10);O;TAB(14);P
750 CT=CT+1
760 PRINT"MAGIC SQUARE NUMBER ";CT
770 PRINT"PRESS <ENTER> TO CONTINUE";
775 INPUT X$
780 S(D)=0:S(G)=0:S(H)=0:S(K)=0:S(L)=0:S(M)=0:
    S(N)=0:S(O)=0:S(P)=0
800 T(J)=0
810 KT=KT+1
820 NEXT J
830 T(I)=0
840 NEXT I
850 T(F)=0
860 NEXT F
870 T(E)=0
880 NEXT E
890 T(C)=0
900 NEXT C
910 T(B)=0
920 NEXT B
930 T(A)=0
940 NEXT A
950 PRINT
960 PRINT"THAT'S ALL THE DIFFERENT MAGIC"
970 PRINT"SQUARES THERE ARE."
```

Even the simplest magic square has a tremendous number of integer combinations that the computer must consider. Although trial and error soon shows that a 2 by 2 magic square is impossible, a 3 by 3 square of the first nine integers requires consideration of the 362,880 possible arrangements of these integers. Furthermore, each possibility must be tested in up to eight ways corresponding to the number of rows, columns, and diagonals that must add up to the same number.

As you can well imagine, the situation with 4 by 4 magic squares is even more staggering. In order to wade through this morass of possibilities, we set up a system of linear equations based on the definition of a magic square. Using elementary algebra, we reduce the number of possibilities to a more manageable size. Readers may want to skim through the following technical section that describes the equations and go straight to the program, then reread the technical section later for a full explanation of the program.

The Method

We first write out a 4 by 4 array using the variables A through P to represent the integers 1 through 16.

A	B	C	Ⓓ
E	F	Ⓖ	Ⓗ
I	J	Ⓚ	Ⓛ
Ⓜ	Ⓝ	Ⓞ	Ⓟ

The uncircled letters represent *primary variables* because if we know these, we can compute the values of the circled letters, which we call *derived variables.*

The variables in the square represent successive integers from 1 through 16 and add up to 136. Therefore, each of the four columns must add up to one-quarter of 136, or 34. Because the square is magic, each of the rows and diagonals must also add up to 34. From these facts we can come up with equations for five of the derived variables:

$$\begin{aligned} D &= 34 - A - B - C \\ M &= 34 - A - E - I \\ G &= 34 - D - J - M \\ H &= 34 - E - F - G \\ N &= 34 - B - F - J \end{aligned}$$

Finding K, L, O, and P in the lower right-hand corner of the square requires a slightly different procedure. First, we add two equations derived from the fact that both the row containing O (row MNOP) and the column containing O (column CGKO) add up to 34:

$$\begin{array}{r} O + P = 34 - M - N \\ O + K = 34 - C - G \\ \hline 2 \times O + K + P = 68 - C - G - M - N \end{array}$$

From the sum above, we subtract an equation for the diagonal AFKP. We can write this equation as

$$K + P = 34 - A - F$$

The result of the subtraction is

$$2 \times O = 34 + A - C + F - G - M - N$$

Dividing by two, we find that

$$O = (34 + A - C + F - G - M - N)/2$$

Once we know O, we can readily calculate K, L, and P.

$$\begin{aligned} K &= 34 - C - G - O \\ L &= 34 - I - J - K \\ P &= 34 - M - N - O \end{aligned}$$

Using the equations we derived, we can now write a program that in theory can find all possible 4 by 4 magic squares.

The BASIC Program

The program in listing 1 is for the TRS-80 Color Computer with 16K bytes of random-access memory (RAM). With very few changes, it should run on any computer that has Microsoft BASIC. Because the program must search for squares within a huge range of possibilities, it generates the 4 by 4 magic squares rather slowly. The computer produces approximately one 4 by 4 square per hour, but the rate is actually very uneven. The computer begins by looking for squares whose A and B variables are 1 and 2, respectively. After finding all of these squares, it changes the B variable to 3. In order to produce 4 by 4 magic squares with different starting numbers, we can, however, modify the program by letting the A and B variables begin at any nonidentical numbers from 3 to 16. When we used this technique, the computer came up with the following typical magic squares:

1	2	15	16
12	14	3	5
13	7	10	4
8	11	6	9

8	15	2	9
5	4	13	12
10	1	16	7
11	14	3	6

12	15	2	5
1	4	13	16
14	9	8	3
7	6	11	10

16	9	4	5
1	6	15	12
14	11	2	7
3	8	13	10

In one long working day, the computer discovered 24 different 4 by 4 magic squares. Finding this many nonequivalent 4 by 4 squares without using a computer would be quite a chore. Here's what Jim Moran, the author we previously referred to, has to say on the subject: "I was determined to make a 4 by 4 magic square—after all, there are only 16 numbers to juggle—but after three weeks of juggling, I still couldn't make one . . . . I then consulted the major encyclopedias; they helped some but not much . . . . I finally made my first 4 by 4 all by myself and gave a party to celebrate."

Mr. Moran goes on to say that there are 880 ways to arrange the first 16 integers to make 4 by 4 magic squares. Finding them all by our computer program might take 5 or 6 weeks, but finding them manually by trial and error would almost be more than one person could accomplish in a lifetime.

Before leaving the subject of magic squares, we

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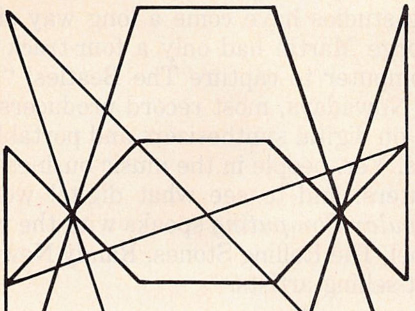
Listing 2: A BASIC program that produces geometric figures by connecting magic-square numbers in sequence. The program is exclusively for the TRS-80 Color Computer with Extended BASIC.

```
1   CLS
2   PRINT:PRINT:PRINT:PRINT
3   PRINT"        MAGIC LINE"
4   PRINT
5   PCLEAR 4
10  PRINT"MAGIC LINE CONNECTS ALL OF THE"
11  PRINT"POINTS FROM A 4×4 MAGIC SQUARE"
12  PRINT"IN NUMERICAL ORDER TO PRODUCE"
13  PRINT"GRAPHICS PATTERNS ON THE SCREEN."
15  PRINT:PRINT:PRINT
16  INPUT"PRESS <ENTER>";A$
20  CLS
30  PRINT:PRINT:PRINT
40  PRINT"AN EMPTY FORM FOR A MAGIC SQUARE";
41  PRINT"WILL APPEAR. IMAGINE THAT ITS"
42  PRINT"BOXES ARE IN ALPHABETICAL ORDER.";
43  PRINT"WHEN THE LETTERS APPEAR, ENTER"
44  PRINT"THE CORRESPONDING NUMBERS FOR"
45  PRINT"EACH ONE."
46  PRINT:PRINT
50  PRINT"        PRESS <ENTER>"
60  INPUT"   WHEN YOU'RE READY";A$
70  PMODE 4,1
80  PCLS
90  SCREEN 1,0
100 LINE(28,13)-(204,189),PSET,B
110 FOR Y=13 TO 189 STEP 44
120 LINE(28,Y)-(204,Y),PSET
130 NEXT Y
140 FOR X=28 TO 204 STEP 44
150 LINE(X,13)-(X,189),PSET
160 NEXT X
170 FOR X=50 TO 182 STEP 44
180 FOR Y=35 TO 167 STEP 44
190 PSET (X,Y)
200 NEXT Y,X
210 FOR K=1 TO 1000:NEXT K
220 CLS
221 PRINT"   A    B    C    D"
222 PRINT"   E    F    G    H"
223 PRINT"   I    J    K    L"
224 PRINT"   M    N    O    P"
230 DIMH(16),V(16)
240 INPUT"A";A
250 INPUT"B";B
260 INPUT"C";C
270 INPUT"D";D
280 INPUT"E";E
290 INPUT"F";F
300 INPUT"G";G
310 INPUT"H";H
320 INPUT"I";I
330 INPUT"J";J
340 INPUT"K";K
350 INPUT"L";L
360 INPUT"M";M
370 INPUT"N";N
380 INPUT"O";O
390 INPUT"P";P
400 H(A)=50:V(A)=35
410 H(B)=94:V(B)=35
420 H(C)=138:V(C)=35
430 H(D)=182:V(D)=35
440 H(E)=50:V(E)=79
450 H(F)=94:V(F)=79
460 H(G)=138:V(G)=79
470 H(H)=182:V(H)=79
480 H(I)=50:V(I)=123
490 H(J)=94:V(J)=123
500 H(K)=138:V(K)=123
510 H(L)=182:V(L)=123
520 H(M)=50:V(M)=167
530 H(N)=94:V(N)=167
540 H(O)=138:V(O)=167
550 H(P)=182:V(P)=167
560 PMODE 4,1
570 PCLS
580 SCREEN 1,0
590 LINE(40,25)-(192,177),PSET,B
600 LINE(H(1),V(1))-(H(2),V(2)),PSET
610 FOR Q=3 TO 16
620 LINE-(H(Q),V(Q)),PSET
630 NEXT Q
640 LINE(H(16),V(16))-(H(1),V(1)),PSET
650 GOTO 650
```

should mention their artistic possibilities. If we connect the integers of a magic square in increasing order, we usually obtain a very interesting pattern. According to Martin Gardner in *Mathematical Puzzles & Diversions* (Simon and Schuster, 1961), such patterns have been used for textile and other designs. Yet drawing the lines that connect the integers of magic squares quickly becomes tedious. Fortunately, we can get a computer to draw the lines by using the program in listing 2. This program is written exclusively for the TRS-80 Color Computer with Extended BASIC.



If we insert the numbers from Albrecht Dürer's magic square into this program, we get a design whose balanced structure expresses the underlying symmetry of this historic magic square (see the illustration above). ☐

But It Won't Run on *My* Computer!

Many readers have asked for help in getting Microsoft BASIC programs to run on Apple and other computers. With help from Erich Whitney, a computer science student, we've managed to translate some of the most popular programs from past articles in The Program Factory. So far, we have an assortment of program listings for:

☑ Applesoft BASIC
☑ Commodore 64/VIC-20 BASIC
☑ TI 99/4A
☑ Timex 1000/Sinclair ZX81 with 16K-byte RAM
☑ TRS-80 Color Computer Extended BASIC

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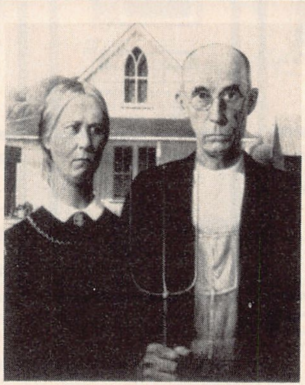

American Gothic – Grant Wood

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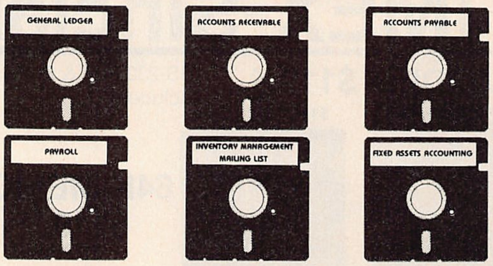

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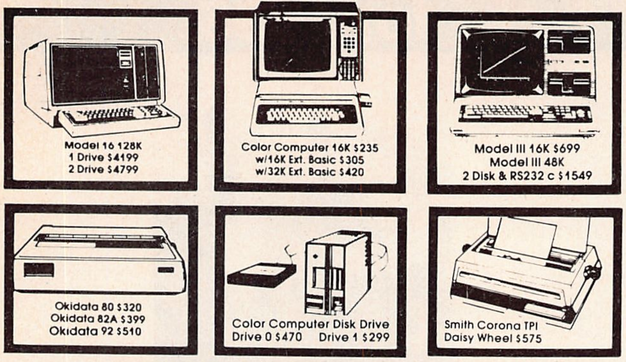

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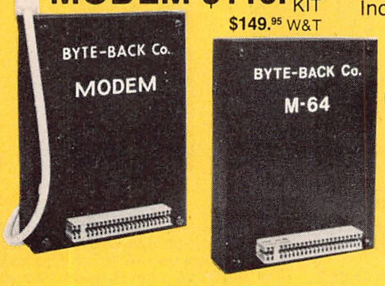

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Computers in the Music Business

Recording studios have come a long way since 1967 when George Martin had only a four-track recorder and no computer to capture The Beatles' "Sergeant Pepper." Nowadays, most record producers and artists insist on digital synthesizers and portable mixing computers. Yes, people in the music business are sold on computers, and to see what digital wonders lie ahead *Popular Computing* speaks with the producers of Billy Joel, The Rolling Stones, Randy Newman, and other best-selling artists.

Database Management Systems

If the acronyms FMS, RDBMS, and NDBMS seem vaguely familiar but not crystal clear to you, then our upcoming excerpt from David Kruglinski's book *Data Base Management Systems* (Osborne/McGraw-Hill, 1983) should be very illuminating. Kruglinski deftly explains the differences among file management systems, relational databases, and network database systems, but, most important of all, he provides some standards for judging and comparing database-management packages.

Battle of the Spreadsheets

As much as we'd like to believe it, mastering a spreadsheet program isn't as simple as uno-dos-tres. Before you spend a lot of money on a spreadsheet package, read next month's feature about the relative merits of Visicalc Advanced Version, Supercalc, and Multiplan. If you're one of those users who have a love/hate relationship with Visicalc—boasting about what it can do and grumbling about what it can't—you'll want to see how Visicalc Advanced Version fares when it goes head-to-head with these two packages.

Spreadsheet Software for Timex/Sinclair

If you've been laboring under the misconception that you *must* own an expensive computer to run spreadsheet programs, check out our review of Vucalc for the Timex/Sinclair 1000. How does it stack up to the established spreadsheet products that run on the more powerful personal computers? We also review the Sinclair version of the arcade classic, Asteroids.

The "Wired" Classroom

Our June educational computing column takes a look at local networks in the classroom and the advantages that such a hook-up provides.

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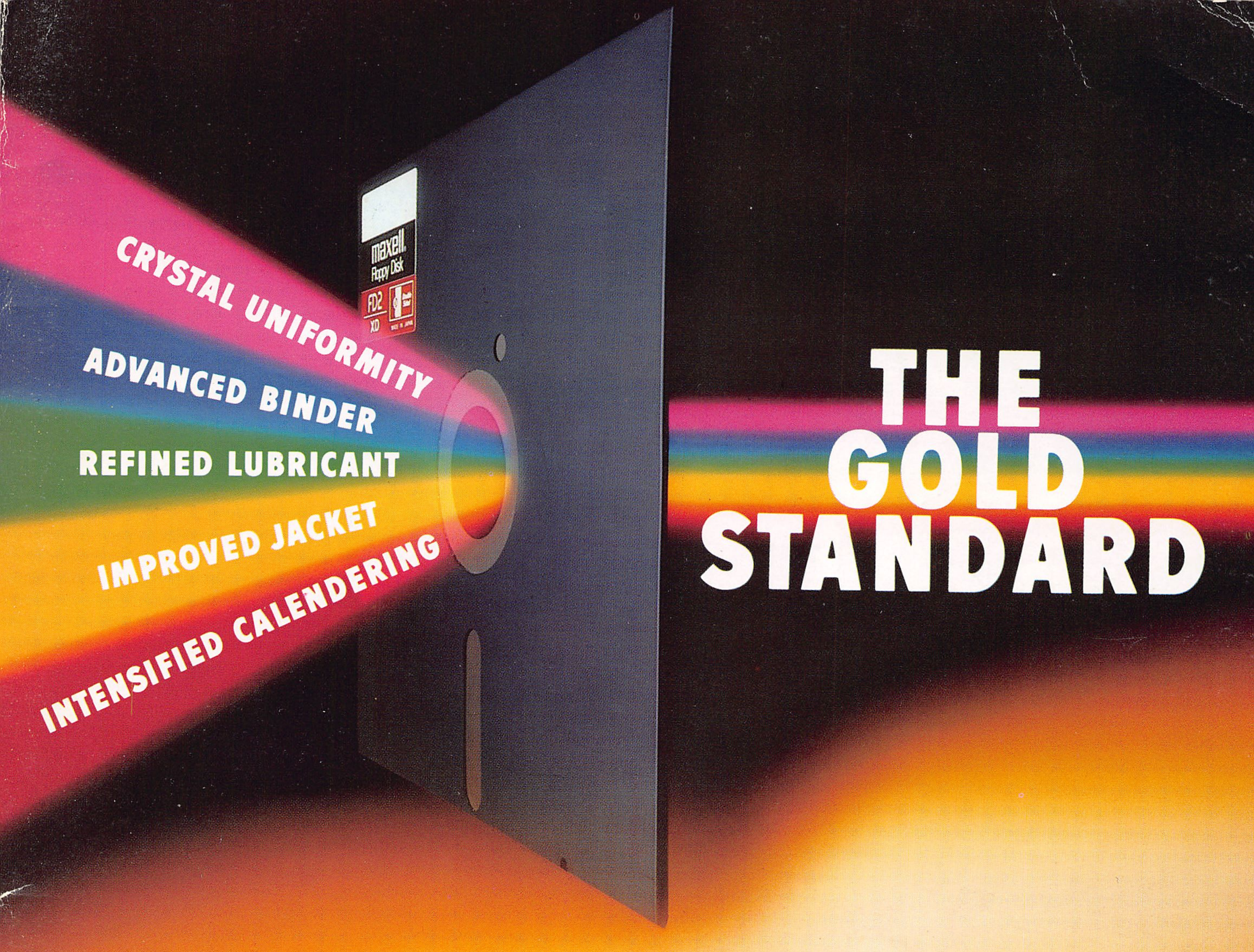
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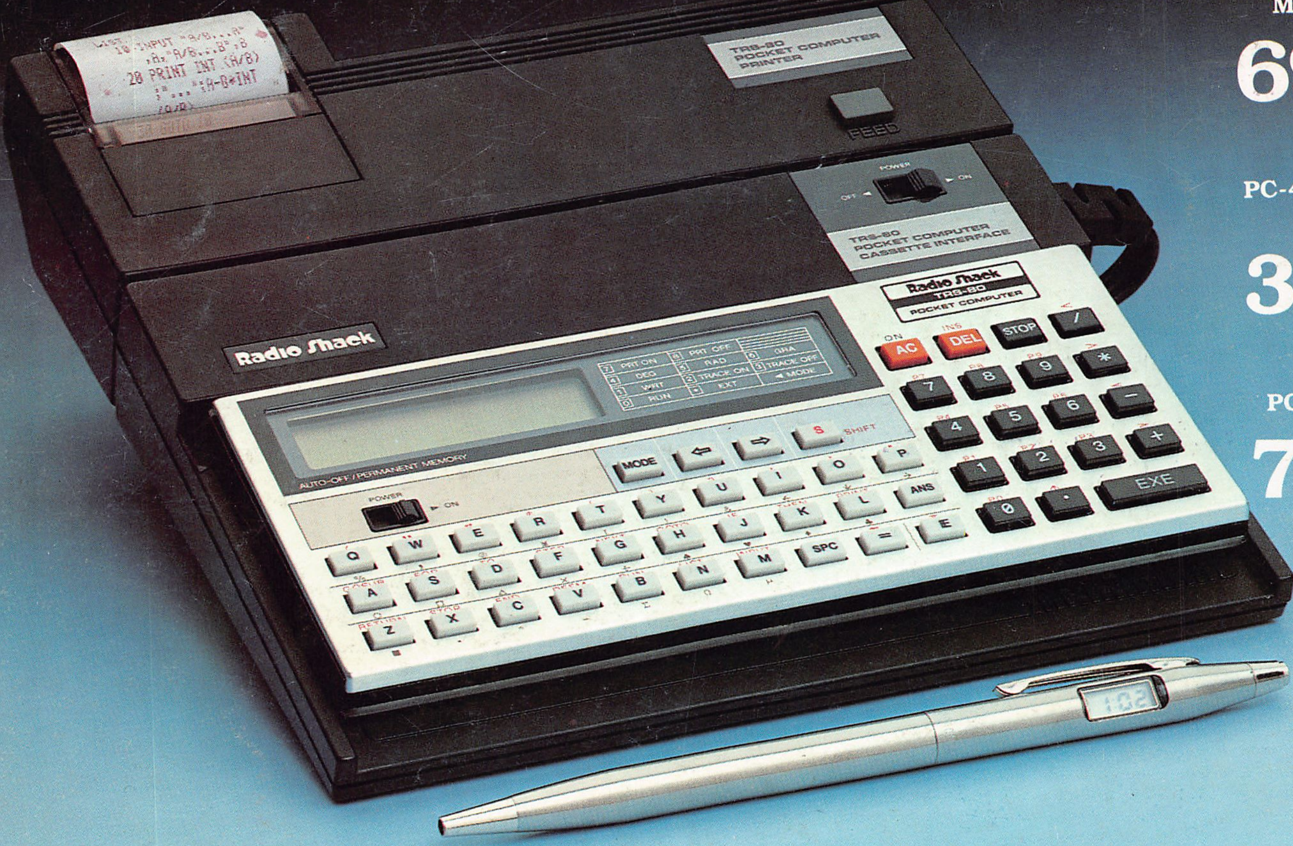
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